A star (*) indicates that the Abstract deals with Apparatus and Instruments.

JULY, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2665. Liquid-Drop Model and Nuclear Moments. K. Way, *Phys. Rev.* 55. *pp.* 963–965, *May* 15, 1939.—The magnetic and electric quadrupole moments of charged spinning drops have been compared with experimental nuclear moments and the agreement found to be very poor. AUTHOR.

2666. Theory of Isotope Separation by Thermal Diffusion. W. H. Furry, R. C. Jones and L. Onsager. *Phys. Rev.* 55. *pp.* 1083–1095, *June* 1, 1939.—The theory is developed of the processes in an apparatus with two concentric tubes, such as that used by Brewer and Bramley. In the first section the process of thermal diffusion in general is described and the theoretical information on the subject reviewed. In Section II are set up the equations for the convection and diffusion processes, and an expression obtained for the net transport of a single isotope which is valid for arbitrary macroscopic properties of the gas. The assumption that the viscosity and heat conductivity of a gas are proportional to the absolute temperature is usually a good approximation; in this case the expression reduces to a simple form. In Section III the transport equation is applied to questions of separation factor and speed of operation. This is done both for the case of discontinuous operation, in which the approach to equilibrium is allowed to reach a certain stage and then the contents of an end-reservoir are removed, and for the case of operation with a continuous flow of gas through the tube. The advantages of the two methods are compared. In the last section the formulæ are applied to a numerical example: the concentration of the C^{13} isotope by the use of methane, in an apparatus of moderate dimensions and power consumption. AUTHORS.

2667. Extended Coordination Theory. Part I. Configuration of Simple Compounds of Typical Elements. R. Tsuchida. *Chem. Soc. Japan, Bull.* 14. *pp.* 101–106, *April*, 1939.—All the chemical linkages may be explained in terms of the coordinate covalence. By assuming that molecules and radical ions are built up by coordination of molecules, ions and electrons as ligands around central kations whose combining fields are given by sets of wave-functions, the configuration of all the simple as well as complex compounds could be readily found. [See Abstracts 4132 and 4533 (1938).] AUTHOR.

2668. Space Arrangements of Atoms. Part I. B. K. Singh. *Indian Acad. Sci., Proc.* 9A. *pp.* 323–327, *April*, 1939.—The author discusses the configuration of N in the 3-covalent state. Whereas the four groups in the 4-covalent state of N are undoubtedly arranged tetrahedrally round the N atom, the molecular configuration of the other type of N compound with 3-covalent N, *e.g.*, NH_3 or an amine having a valency group of 8 electrons of which 6 are shared, remained for long as one of the outstanding problems of stereochemistry. From the repeated failures to resolve tervalent N compounds in which the N atom was linked to 3 different groups, it was concluded that the molecule possessed a plane of symmetry, but the present author now brings forward evidence deduced from stereochemical considerations for the non-planar distribution of the three valencies in tervalent N compounds. This viewpoint finds support also from physical properties, such as the electric moment, crystal structure, and absorption spectra in the infra-red, which are correlated with the space arrangement of the molecule. Rapid racemisation is held to account for the failures to obtain resolution into optically active forms. H. H. Ho.

2669. Molecular Configuration of Diphenyl Ether from Dipole Moment Data. K. Higasi and S. Uyeo. *Chem. Soc. Japan, Bull.* 14. *pp.* 87–101, *April*, 1939.—The dipole moments of 2,2′-dinitro-, 2,2′-diiodo- and 2,2′dimethyl-diphenyl ethers were measured in benzene and hexane solutions at 27° and 50°. Four isomers of dimethyl-diphenyl ethers were also studied in benzene solution at 30°. The results obtained for them lead to the conclusion that each benzene ring is perpendicular to the other ring in the molecules considered. AUTHORS.

2670. Structure of PCl_5 in Relation to Steric Hindrance of Component Atoms. H. Moureu, A. M. de Ficquelmont, M. Magat and G. Wetroff. *Comptes Rendus*, 208. *pp.* 1579–1581, *May* 15, 1939.—The distance P-Cl in PCl_5 being approximately 2·09 Å, and the minimum possible distance Cl-Cl in a compound being taken as 2·7 Å, the distances Cl-Cl deduced for the various structures proposed for PCl_5 are compared with this minimum. The result negatives the suggestion that P is at the centre of 5 Cl atoms arranged in a pentagon, which gives Cl-Cl = 2·46 Å; it is compatible with that which places the 5 Cl atoms at the points of a square pyramid with the P at about the centre of the base (Cl-Cl = 2·96 Å). It is still more favourable to the authors' structure, a trigonal bipyramid Cl-Cl = 2·96 and 3·62 Å. [See Abstract 4559 (1937).] C. A. S.

2671. Structure of Iron Pentacarbonyl, and of Iron and Cobalt Carbonyl Hydrides. R. V. G. Ewens and M. W. Lister. *Faraday Soc., Trans.* 35. *pp.* 681–691, *June*, 1939.—The structures of $Fe(CO)_5$, $Fe(CO)_4H_2$ and $Co(CO)_4H$ have been investigated by the method of electron diffraction of their vapours. $Fe(CO)_5$ has a trigonal bipyramidal structure, while the hydrides show a tetrahedral arrangement of the CO groups, and should be formulated as $Fe(CO)_2(COH)_2$ and $Co(CO)_3(COH)$ respectively. The bond lengths have been determined and the metal-carbon bonds, when compared with the sums of the single bond covalent radii, are observed to show shortenings similar to those found in other metallic carbonyls. AUTHORS.

2672. Quantum Mechanical Discussion of the C-Cl Bond in the Substituted Ethylenes and Benzenes. J. Sherman and J. A. A. Ketelaar. *Physica*, 6. *pp.* 572–580, *June*, 1939. *In English.*—A calculation by the molecular orbital method of the amount of double bond character of C-Cl bonds in the chlorethylenes and chlorobenzenes is carried out, and is shown to lead to results in agreement with the experimental values of interatomic distances obtained by electron diffraction investigation. AUTHORS.

2673. Association of Ions in a Bi-Univalent Electrolyte. A. R. Miller. *Faraday Soc., Trans.* 35. *pp.* 691–697, *June*, 1939.—In this paper the association of ions in a bi-univalent electrolyte is considered. The new feature introduced, compared with the simple case of a uni-univalent electrolyte considered by other investigators, is that in addition to free ions and associated groups of zero nett electric charge the possibility must also be considered of configurations representing various intermediate stages of association and it is concluded that such configurations are highly probable. This is in agreement with what has been surmised from conductivity measurements. AUTHOR.

2674. Molecular Size of Methylated Cellulose. M. L. Wolfrom, J. C. Sowden and E. N. Lassettre. *Am. Chem. Soc., J.* 61. *pp.* 1072–1076, *May*, 1939.—From sulphur analyses of mercaptalated products of methylated cellulose, the authors derive an equation for the rate of change of the degree of polymerisation of these products and hence obtain the value 400 ± 70 glucose units for the initial average degree of polymerisation of the methylated cellulose. The value 350 ± 35 is obtained for the corresponding cellulose acetate. W. H. WAL.

2675. Molecular Weight and Vapour Pressure of Se. K. Neumann and E. Lichtenberg. *Zeits. f. phys. Chem.* 184. *Abt. A.* 2. *pp.* 89–99, 1939.—By means of the special type of apparatus previously described [see Abstract 3333 (1931)], with which molecular weight determinations can be carried out at pressures of 10^{-3} to 10^{-4} mm. Hg, the degree of association of Se vapour over solid metallic Se is measured at approximately 200° C. The value of n in Se_n is found to be $6{\cdot}0 \pm 0{\cdot}3$. The vapour pressure p is measured in the neighbourhood of the melting point of Se. The equations $\log p = 12{\cdot}78 - 7440/\mathrm{T}$ and $\log p = 8{\cdot}63 - 5391/\mathrm{T}$ are found to hold for the metallic Se and molten Se respectively (p in mm. Hg; T in °Abs.). The calculated heats of sublimation and fusion are respectively 33·92 and 24·58 kg. cal./mol. L. A. W.

See also Abstracts 2712, 2760, 2844, 2881, 2899, 2909, 2915, 2919.

COLLOIDS.

2676. Shape of Tobacco Mosaic Virus Particles in Solution. J. R. Robinson. *Nature*, 143. *pp.* 923–926, *June* 3, 1939.—The ease with which solutions of the tobacco mosaic virus protein show a strong double refraction of flow suggests that the particles present are extremely elongated, and their X-ray study by Bernal and Fankuchen indicates that the long tapering structures are paracrystals which consist of long rigid rods, packed closely side by side, but without order, in the direction of their length. It has now been shown clearly that the double refraction of flow does in fact arise from the orientation of rigid rods, and not from the deformation of flexible particles. The work (principally on viscosity) of Bawden and Pirie, Kuhn, Staudinger, Lauffer, Frampton and Neurath, Taylor, and Peterlin is briefly reviewed in the paper. The methodological problem is summed up in the statement that the viscosity of a suspension is most emphatically not a simple physical property of that suspension, as it would be of a newtonian liquid. The energy dissipated depends upon the type and upon the rate of flow; so the recorded viscosity depends upon the method of measurement, and especially upon the rate of shear which is employed. Much of the work referred to is found to be invalid in the light of these controlling factors. H. H. Ho.

2677. Densities of Various Fibres and Widths of Intermicellar Spaces. Y. Matsunaga. *Kyoto Coll. Sci., Mem.* 21. *pp.* 219–232, *Nov.*, 1938. *In English.*—Intermicellar spaces of various textile fibres were examined by measuring their densities and their swellings in water, in various primary normal alcohols, and in liquid paraffin. It was observed that the density of a fibre which was measured in methyl alcohol was greater

than those measured in the other liquids, and that the density decreased with the number of C atoms of the alcohols and the liquid paraffin.
AUTHOR.

2678. Microscopic Methods used in Identifying Commercial Fibres. T. M. Plitt. *Bureau of Standards, Circ. No. C423.* [**26** *pp.*], **1939.**—A compilation of about 50 microscopic methods for the identification of paper, textile, and cordage fibres has been made. During a survey of the literature these were selected and tried in the fibre-testing laboratory. Their relative merits are discussed. Specifically there are included the following: general directions for the preparation of samples for examination, and for the determination of percentage of constituents present; general tests for orientation; tests for the identification of ground wood, sulphite, sulphate, coniferous, deciduous, and bleached wood pulps; of cotton, used cotton, mercerised cotton, flax, ramie, wool, damaged wool, casein fibre, silk, "wild" silk, and the different rayon fibres; also of hemp, sisal, jute, coconut, and abacá (manila). In addition to inspection by the aid of magnification, the means of approach include staining reactions, ashing preparation, and the use of polarised and u.v. light. References to original sources and standard pertinent works are appended. AUTHOR.

2679. Structure of Natural Cellulose. H. Kiessig. *Zeits. f. phys. Chem.* **43.** *Abt. B.* **2.** *pp.* **79–102, 1939.**—The author reviews the existing knowledge regarding the structure of the cellulose molecule and re-investigates some of the X-ray data about which there has been much controversy in recent papers by Sauter and by Mark and Meyer [see Abstract 3828 (1937)]. From a consideration of X-ray photographs reproduced in Sauter's paper and of those taken by the author he concludes that some of the difficulty in reconciling the results of Sauter with those of Mark and Meyer is due to non-homogeneity of the radiation used by Sauter. No molecular model of cellulose so far postulated will completely satisfy all the experimental facts. J. I.

2680. ζ-Potential at Boundary Surface Solid/Water in Relation to Internal Micellar Structure of the Former. Part I. K. Kanamaru and T. Takada. *Zeits. f. phys. Chem.* **184.** *Abt. A.* **3.** *pp.* **179–196, 1939.**—From several typical examples it has been found of interest to investigate the relationship between micellar (or crystal) structure and the ζ-potential of an adsorptive [see also Abstract 896 (1939)]. In this paper the charge of ζ-potential during the direct conversion of cellulose hydrate into natural cellulose has been investigated with respect to the hygroscopic condition and the following data established: (*a*) The equilibrium value of the ζ-potential ζ_∞ of cellulose hydrate is increased by thermal treatment in ethylene glycol, *i.e.*, by its direct transformation into natural cellulose; (*b*) the decrease of the ζ-potential $\zeta_0-\zeta_\infty$ and the velocity $-(d\zeta/dt)$ is diminished and also the hygroscopic state of cellulose hydrate is lowered by the above treatment. From the standpoint of Kanamaru's theory of the lyophilic nature of the solid phase, a plausible interpretation may be given to the above phenomena. H. H. Ho.

***2681. Direct Photography for Electrophoresis Diagrams. H. Svensson.** *Kolloid Zeits.* **87.** *pp.* **181–186,** *May,* **1939.**—Philpot's ultracentrifuge method [see *Nature,* 141. *p.* 283, *Feb.* 12, 1938] for the production of sedimentation diagrams has now been introduced into the electrophoresis apparatus [see Abstract 1900 (1937)] and the following improvements are described: By use of slits in place of knife edges true curves were obtained instead of Philpot's boundaries between light and dark fields. By introduction of a wedge-shaped slit, the width of the horizontal section of the curve could be reduced. By means of a special device, the direct registration of the base line in the camera was accomplished. Quantitative examples are included in the paper. H. H. Ho.

2682. Streaming Potential and Electroosmotic Counter Effect. M. A. Lauffer and R. A. Gortner. *J. Phys. Chem.* **43.** ***pp.*** **721–732,** ***June,*** **1939.**—The electroosmotic counter pressure theory has been investigated qualitatively and quantitatively. The results of this study can be rationalised with a high degree of success in terms of the counter pressure theory. This constitutes a second justification for applying the theory of Helmholtz to streaming potential studies involving organic liquids. The original justification is the fact that streaming potentials of such systems have been shown to be directly proportional to the pressures of streaming, as the Helmholtz equation demands. The effective mean pore size of a cellulose diaphragm containing ethyl acetate has been calculated in accordance with the back pressure theory and found to have the value of 0·27 micron. AUTHORS.

2683. Crystallisation of Crude Rubber. C. Park. *Kyoto Coll. Sci., Mem.* 22. *pp.* 13–25, *Jan.*, 1939. *In English.*—The identity of crystallisation in a stretched smoked sheet of rubber, in pale crepe, and in frozen rubber was established. A small expansion by freezing was found in smoked sheet ribbons of rubber stretched in various degrees. Maximum expansion occurred with the stretching of about 200–300% of the original length, and there was no, or almost no expansion in the case of stretching which was higher than about 700%. From these facts a new theory was proposed to explain the crystallisation of rubber by stretching, milling, freezing and compressing. In this theory long chain molecules of rubber are considered to form large irregular spirals having numerous isoprenes, many more than two, in one turn of the spirals. AUTHOR.

2684. Supersaturation and Liesegang Ring Formation. III. A. van Hook. *Kolloid Zeits.* 87. *pp.* 125–127, *May,* **1939.**—Since the original observations of rhythmic precipitation by Liesegang, a considerable literature has grown with respect to their mechanism of formation of which the supersaturation theory of Ostwald was pre-eminent. Objections to this theory have been based on the failure to obtain a proof of supersaturation, and on the facts that rings also arise when nuclei of the material to be precipitated are present. Further qualitative and quantitative observations have recently been published [for Parts I and II see Abstract 496 (1939)] on the above points, and the present paper is an extension of this work. An expression is derived directly from a relationship given by Jablynski, and it is shown that the earlier observations on ring formation are in agreement with it. The expression given by Christiansen and Wulf [Abstract 3473 (1934)] is shown to be serviceable when a calculated instead of an observed number of rings is taken.

H. H. Ho.

2685. Liesegang Rings Obtained by Attacking Solid Suspensions of Large Particles in Gelatin. S. Veil. *Comptes Rendus,* **208.** ***pp.*** **1496–1498,** ***May*** **8, 1939.**—Liesegang rings of Ag_2CrO_4 have been obtained by adding $AgNO_3$ solution to gelatin containing $ZnCrO_4$ in suspension, and by adding $K_2Cr_2O_4$ solution to a suspension of particles of silver borate in gelatin. The mechanism of the process is discussed.

A. J. M.

2686. Colloidal Impurities in Distilled Water. S. W. Pennycuick and C. E. Woolcock. *J. Phys. Chem.* 43. *pp.* 681–685, *June*, 1939.—Some at least of the substances in distilled water which inhibit the formation of formaldehyde-reduced gold sols are positively charged hydrophobic colloids. Their inhibitory effect can be reduced and sometimes completely removed by (*a*) allowing the water to stand undisturbed for some weeks, (*b*) freezing the water, and (*c*) adding very small amounts of stannic chloride at pH between 9·7 and 10·3. AUTHORS.

See also Abstracts 2707, 2712, 2864, 2865, 2868, 2890, 2955, 2962, 2991.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2687. Fourier Lattice and Thermal Agitation. C. Mauguin and J. Laval. *Comptes Rendus*, 208. *pp.* 1446–1450, *May* 8, 1939.—The authors investigate theoretically the effect of thermal agitation of scattering centres on the usual Fourier series method of expressing the electron distribution of crystal lattices. They find that the effect can be correlated with the results obtained by Laval [see following Abstract] on the distribution of diffuse scattering around a Bragg reflection direction. J. I.

2688. Scattering of X-Rays by Crystals about the Direction of Selective Reflection. J. Laval. *Comptes Rendus*, 208. *pp.* 1512–1514, *May* 8, 1939.—The author has studied the distribution and intensity of diffuse scattering of monochromatic X-rays about certain Bragg reflection directions in crystals of sylvine, calcite, diamond and Al. The main results are concerned with the scattering around the (004) reflection of sylvine and it is shown that iso-diffusion surfaces can be constructed. This diffuse scattering is far from negligible and it is attributed in the main to thermal agitation of the scattering centres. [See preceding Abstract.] J. I.

2689. Elastic Eigen-Oscillations of Crystals with Mixed Boundary Conditions. H. Wierzejewski. *Zeits. f. Krist.* 101. 1–2. *pp.* 94–116, 1939.—A mathematical treatment under the following heads:—1. Elastic waves in an endless crystal. 2. Boundary conditions and oscillations of half-space and plate. Usual bounding conditions, oscillations of an endless plate between $nr = d_1$ and d_2. 3. Effect of plane boundaries of various orientation. K bounding with point group P, space group R and extent K_0. Form with different extents of K_0. Calculation (*a*) *without* translation group, *i.e.*, $R = P$, K_0 extended endlessly in 3 dimensions—half space, spatial side or angle; (*b*) with one *linear* translation group, endless extension in 2 directions—plate, half plate, plate corner; (*c*) with one *plane* transformation group, endless extension in 1 direction—prism, semi-prism; (*d*) with one *spatial* translation group, endless extension in all directions—finite prism or pyramid. The space-system R. Production and symmetry of oscillations, each K oscillation possesses *at least* the symmetry of the corresponding space group R. Possible bounding forms and conditions. 4. Type A oscillations, permissible extension vectors. Simplified production, running and stationary oscillations. Degeneration for singular points of the extension surface or as a result of elastic symmetry. Completeness of the eigen-oscillation-system of type A. D. R. H.

2690. Recent Problems and Developments in Metallography. A. Kochendörfer. *Kolloid Zeits.* 87. *pp.* 78–87, *April*, 1939.—A critical review under the heads: (1) equilibrium and non-equilibrium conditions; (2) fundamentals of kinetics; (3) mosaic structure in crystals; (4) precipitation of supersaturated solid solutions (age hardening alloys); (5) elasticity of crystals; (6) allotropic (lattice) transformations in pure metals; (7) lattice transformations in solid solutions (hardening of steel). A bibliography of 34 references, mainly German, is appended. D. R. H.

2691. Structures of Ni$_3$Ti and Si$_2$Ti (Two New Types). F. Laves and H. J. Wallbaum. *Zeits. f. Krist.* 101. 1–2. *pp.* 78–93, 1939.—Ni$_3$Ti can be described formally as the superlattice of a close cubic packing, analogous with the case of Mg$_3$Cd. It resembles closely the structure of Ni$_3$Sn, the differences between them being similar to those between MgZn$_2$ and MgNi$_2$. By raising the temperature and altering the concentration it is possible to pass continuously from Mg$_3$Cd to Mg, but the range of composition of the Ni$_3$Sn lattice is very narrow. The combination effect is yet more marked with Ni$_3$Ti and the structure rather more complicated than with Ni$_3$Sn. Si$_2$Ti can be formally described as the superlattice of a close cubic packing of coordination number 10, but it may better be regarded as a typical intermetallic compound, like Si$_2$Mo or Si$_2$W. Powder photographs with Cu radiation required special precautions to overcome orientation effect. D. R. H.

2692. Evidence for a Superlattice in Ni$_3$Fe. P. Leech and C. Sykes. *Phil. Mag.* 27. *pp.* 742–753, *June*, 1939.—Plots of specific heat and of saturation intensity/unit mass, each against temperature, up to 650° C., are given for a synthetic "permalloy" in three states:—(*a*) quenched from 700° C., (*b*) cooled at 1° C./min. from 650° C., (*c*) very slowly cooled in the interval 490°–370° C. The plot of Σh^2 against $\sin^2 \theta$ with CuKα radiation and Ni filter is a straight line, both for main and superlattice lines. By melting specially pure materials *in vacuo* in a h.f. induction furnace a composition of 24·91% Fe, 75·04% Ni, 0·2% Al, was attained. In Ni$_3$Fe only a single minimum occurs in the specific heat curve, at about 550° C., compared with two in Cu$_3$Au [see Abstract 4475 (1936)]. It is deduced that the alloy can undergo an order/disorder transformation, but it is not clear how this can explain its remarkable magnetic properties. To obtain the high permeability a cooling rate not less than 1° c./min. in the interval 500°–400° is necessary. In this process about 30% of the transformation energy is released, so that if antiphase nuclei still exist they will be about 30 Å in length. The specific heat of Ni$_3$Fe is 2–6% greater when annealed than when quenched, in the range 200°–300° C. [See also Abstracts 3107 (1934), 4450 (1935), 1422 (1936) and 3347 (1937).] D. R. H.

2693. Superstructures in Fe-Ni-Co Alloys. S. Kaya and M. Nakayama. *Zeits. f. Physik*, 112. 7–8. *pp.* 420–429, 1939.—The authors report measurements of the specific heat of face-centred cubic lattices in Fe-Ni-Co alloys, by Syke's method. Immediately above 500° C. in almost all the alloys, an anomalous increase in the specific heat occurs which becomes very marked indeed as the composition Ni$_3$Fe is approached—due apparently to formation of an "ordered" structure as reported by Dahl [see Abstract 3434 (1936)]. For the alloy perminvar with Fe 30% and Ni 45%, the specific heat/temperature plot shows a much sharper maximum after ageing than when quenched. The authors conclude that "long range order" is produced in various places within individual crystals while the remainder remains in "short range order"; and state that under these conditions the marked difference between the magnetic properties of ordered and disordered alloy is sufficient to explain completely the peculiar hysteresis characteristics. D. R. H.

2694. Line-Broadening with Deformed Metals. U. Dehlinger and A. Kochendörfer. *Zeits. f. Krist.* 101. 1–2. *pp.* 134–148, 1939.—The breadths of all the X-ray diffraction lines of rolled and beaten copper are measured. Two possible states of strain are recognised, the first corresponding to homogeneous extension and compression of the particles, and the second to simple bending of the particles with a superimposed short-period distortion. The line-broadening due to strain can be distinguished from that due to particle size by the different way in which it varies with the angle of diffraction in the two cases. [See following Abstract.] J. T.

2695. Line-Broadening with Cosine-Formed Lattice Distortion. A. Kochendörfer. *Zeits. f. Krist.* 101. 1–2. *pp.* 149–155, 1939.—The intensities of the Debye-Scherrer lines are calculated as a function of the angle of diffraction and it is shown that each line is split up into two lines symmetrically displaced from the Bragg position. [See preceding Abstract.] J. T.

2696. Transformation of FeS. H. Haraldsen. *Zeits. f. Elektrochem.* 45. *pp.* 370–372, *May*, 1939.—The α- and β-transitions of FeS at 135 and 325° C. are discussed with special reference to the lattice changes. H. J. H. S.

2697. Unit Cell and Space Group of Cs_2CuCl_4. D. P. Mellor. *Zeits. f. Krist.* 101. 1–2. *pp.* 160–161, 1939. *In English.*—Crystal data of orthorhombic Cs_2CuCl_4 are as follows: $a = 9\cdot69$, $b = 12\cdot33$, $c = 7\cdot58$ Å, density $= 3\cdot42$, 4 mol. per unit cell, probable space group $\mathrm{D}^{16}_{2h} - \mathrm{P}^{n}_{am}$. Preliminary results are given as follows for the closely related tetramethylammonium cupric salt, $a = 12\cdot11$, $b = 15\cdot5$, $c = 9\cdot05$ Å, density $= 1\cdot38$, 4 mol. per unit cell, probable space group $\mathrm{D}^{16}_{2h} - \mathrm{P}^{n}_{am}$. J. I.

2698. Arrangement of Micro-Crystals of Silver Bromide Electrodeposited on the Anode Silver Plate. S. Shimadzu. *Kyoto Coll. Sci., Mem.* 22. *pp.* 27–33, *March*, 1939. *In English.*—X-ray studies on substances electrodeposited on the electrode in the solution of an electrolyte have been carried out mainly on the micro-crystals of metals deposited on the kathode. In the present experiment the writer examined the micro-crystals of AgBr electrodeposited on the anode silver plate in a water solution of KBr. AUTHOR.

2699. Structure of Diphenylamine. Part I. J. Dhar. *Indian Journ. Phys.* 13. *pp.* 27–29, *Feb.*, 1939.—Goniometric measurements on diphenylamine crystals reveal that they belong to monoclinic holohedral class with the following elements :—$a : b : c = 1\cdot01 : 1 : 2\cdot78$ and $\beta = 91° 30'$. From X-ray measurements the cell dimensions are obtained as $a_0 = 14\cdot0$; $b_0 = 13\cdot9$; $c_0 = 39\cdot5$ Å whence the axial ratio is $1\cdot01 : 1 : 2\cdot84$. The number of molecules per unit cell is found to be 32. AUTHOR.

2700. X-Ray Crystal Analysis of Trans-Azobenzene. J. J. de Lange, J. M. Robertson and I. Woodward. *Roy. Soc., Proc.* 171*A*. *pp.* 398–410, *June* 6, 1939.—The crystal structure and molecular dimensions of the ordinary or *trans*-form of azobenzene have been determined by quantitative X-ray investigation. The crystal is isomorphous with the dibenzyl series of structures, and consequently it is possible to make a direct application of the Fourier series method, without assuming any new model for the azobenzene molecule. The resolution of the N atoms is poor, but the $N = N$ distance of $1\cdot23 \pm 0\cdot05$ Å is confirmed. The C–N distance is $1\cdot41 \pm 0\cdot03$ Å, implying conjugation between the benzene ring and the N=N bond. The N=N–C valency angle is 121·5 ± 3°. These results are discussed in relation to other investigations. Two independent molecules contribute to the asymmetric crystal unit. One is practically flat, but in the other the rings lie in different planes 0·32 Å apart. This departure of the second molecule from the planar form is accompanied by small changes in dimensions. The orientations of the molecules and coordinates of the atoms relative to the crystal axes are given. The minimum intermolecular approach distances lie between 3·5 and 3·6 Å. AUTHORS.

2701. Structure of Proteins. I. Langmuir. *Phys. Soc., Proc.* 51. *pp.* 592–612, *July*, 1939.—The present position with regard to the structure of proteins may be summed up as follows. A vast amount of data relating to protein structure has been collected by workers in a dozen different fields. No reasonable doubt remains as to the chemical composition of proteins. The original idea of native proteins as long-chain polymers of amino-acid residues, while consistent with the facts relating to the chemical composition of proteins in general, was not a necessary deduction from these facts. Moreover it is incompatible with the facts of protein crystallography, both classical and modern, with the phenomena of denaturation, with Svedberg's results which show that the native proteins have definite molecular weights, and with the high specificity of proteins discovered in studies in immunochemistry and enzyme chemistry. All these facts seem to demand a highly organised structure for the native proteins, and the assumption that the residues function as two-armed units leading to long-chain structures must be discarded. The cyclol hypothesis introduced the simple assumption that the residues function as four-armed units, and its development during the last few years has shown that this single postulate leads by straight mathematical deductions of the idea of a characteristic protein fabric which in itself explains the striking uniformities of skeleton and configuration of all the amino-acid molecules obtained by the degradation of proteins. The geometry of the cyclol fabric is such that it can fold round polyhedrally to form closed cage-like structures. These cage molecules explain in one simple scheme the existence of megamolecules of definite molecular weights capable of highly specific reactions, of crystallising, and of forming monolayers of very great insolubility. The agreement between the properties of the globular proteins and the cyclol structures proposed for them is indeed so striking that it gives an adequate justification for the cyclol theory, especially in view of the fact that these numerous and varied independent facts are on this theory seen to be logical consequences of one simple postulate. AUTHOR.

2702. Structure of Insulin. I. Langmuir and D. M. Wrinch. *Phys. Soc., Proc.* 51. *pp.* 613–618; *Disc.*, 618–624, *July*, 1939.—The modified (0001) vector projection for an insulin crystal is examined in relation to the C_2 structure proposed for the insulin molecule. It is found that this projection confirms the C_2 structure represented by the discron system $3s + 3s'$—*o* provided it is adequately loaded at its slits. Bernal's suggestion of an 18-discron set structure for the insulin molecule is shown to be untenable, since it is inconsistent with the $z = 0$ vector section. [See Abstract 1888 (1939).] AUTHORS.

2703. Isomorphous Substitution of H, OH, NH_2, CH_3 and Cl in the Lattice of Naphthalene. A. Neuhaus. *Zeits. f. Krist.* 101. 3. *pp.* 177–192, 1939.—Optical and X-ray data are given for naphthalene and for its OH, NH_2, CH_3 and Cl β-substitution derivatives. The lattice parameters *b* are similar in all cases. In the lattice of naphthalene the long axis of the molecule is approximately parallel to the *c* axis and the above derivatives are distinguished in having different inclinations of their molecular long axes to the *c* axes in their respective unit cells. The β-methyl- and β-chloronaphthalenes are practically isomorphous. J. I.

2704. Development of Fibrous Texture in Cold-Worked Rods of Copper. H. C. Vacher. *Bureau of Standards, J. of Research*, 22. *pp.* 651–668, *June*, 1939.—Mono- and bicrystalline rods of copper were subjected to different degrees of cold-swaging and were examined with X-ray diffraction and metallographic methods. The results indicate that swaging causes the crystals to rotate until either an octahedral or a cubic axis becomes parallel with the rod axis. Whether the crystal assumes the octahedral or the cubic orientation depends upon which axis initially formed the smaller angle with the rod axis. Crystals approaching the octahedral orientation developed secondary crystals, after approximately 60% reduction in area. On further swaging, these secondary crystals approached the cubic orientation. Crystals initially approaching the cubic orientation remained one crystal after 95% reduction in area.

AUTHOR.

2705. Preparation and Properties of Hexagonal Form of Nickel. G. Le Clerc and A. Michel. *Comptes Rendus*, 208. *pp.* 1583–1585, *May* 15, 1939.—Cubic Ni, formed by reduction of NiO, on leaving several days at 170° C. in an atmosphere of CO, was transformed into a hexagonal allotrope which is non-magnetic. On subjecting it to thermo-magnetic analysis, the magnetisation was found to increase suddenly from 250° onwards, with a Curie point at 358°. On cooling, however, magnetisation increased rapidly below the Curie point and the X-ray diagram reveals that the hexagonal form has now been reconverted into the cubic. For the hexagonal form, $a = 2{\cdot}65$, $c = 4{\cdot}32$ Å, $c/a = 1{\cdot}63$; atomic volume $= 13{\cdot}1$ Å^3 compared with 11 Å^3 for cubic: transformation of hexagonal into cubic thus causes 5·6% linear contraction, and is endothermic. The reverse, exothermic, transformation does not occur appreciably on cooling since it is too slow. Since $Ni_{hexag} \rightleftharpoons Ni_{cubic}$ occurs between 170° and 250°, ordinary cubic Ni is metastable at room-temperature. The catalytic properties of the two forms are very different. S. J. G.

2706. Crystal Growth. Part II. D. Balarew and N. Kolarow. *Zeits. f. Krist.* 101. 1–2. *pp.* 156–160, 1939.—It is shown that at 23° C. the maximum difference (ca. 2%) exists between the solubility of gypsum crystals in solutions brought to 23° from above and from below respectively. The equilibrium concentration in the case of solutions containing old crystals only is not altered by changing the direction of stirring while that of solutions containing new crystals, prepared under specified conditions, can be affected by changes in the direction of stirring. [For Part I see Abstract 52 (1939).] J. I.

2707. Structure of Solid Systems and Their Contamination. D. Balarew. *Kolloid-Beihefte*, 50. 1–6. [234 *pp.*], 1939.—The author describes at length the conglomerate crystalline structure of solid systems, and the various kinds of contamination to which they are subject. General rules are given for the preparation with the greatest possible purity of the precipitates met with in analytical chemistry. The particular cases of $BaSO_4$, $MgNH_4PO_4$, and $Mg_2P_2O_7$ precipitates are considered in detail.

W. H. WAL.

2708. Colour Centres in KCl Crystals Containing Traces of Alkaline Earth Chlorides. H. Pick. *Ann. d. Physik*, 35. 1. *pp.* 73–83, *May*, 1939.—The KCl crystals, produced by chilling the melt, contained 1–30 alkaline earth ions per 10^6 K^+ ions, and were treated with K vapour to produce $0{\cdot}3 - 1{\cdot}0 \times 10^{17}$ F-centres per cm^3. In addition to the F and F′ absorption bands which are obtained with pure KCl also, new bands Z_1, Z_2, and Z_3 due to the alkaline earth ions, were produced by suitable optical and thermal treatment. All bands are explained in terms of an atomistic model, based on electron transitions and following the lines of the mechanism proposed by Pohl for pure KCl [see Abstract 1277 (1938)]. S. J. G.

2709. Formation of Colour Centres in KI Crystals. R. Vossnack. *Ann. d. Physik*, 35. 2. *pp.* 107–117, *May*, 1939.—In continuation of the work of Rögener [see Abstract 3362 (1937)] on KBr and KCl, the heat of solution of K-atoms in KI-crystals is measured by observing the variation of solubility with temperature; it is found to equal 0·11 eV. It appears essential to let the alkali-vapour circulate in order to keep its pressure independent of reactions with the glass walls of the container. L. E. F.

2710. Measurement and Explanation of "Energy of Crystallisation". C. W. Correns and W. Steinborn. *Zeits. f. Krist.* 101. 1–2. *pp.* 117–133, 1939.—When alum, sodium carbonate or calcium chloride crystallises out from supersaturated solution an increase in volume takes place. This is measured and the corresponding pressure calculated. This pressure depends on the extent of the supersaturation and would be proportional to it were it not for surface forces. J. T.

See also Abstracts 2679, 2683, 2724, 2733, 2798, 2863, 2892, 2949, 2951, 3027, 3033.

DENSITY.

2711. Physical Properties of Nitrobenzene. Part I. J. Mazur. *Acta Physica Polonica*, 7. 4 *pp.* 285–289, 1939. *In English.*—The author has repeated his measurements concerning the relation between density and temperature for nitrobenzene. For the present investigation two samples of nitrobenzene were used. One of them was purified by W. Kessel, the other one by the author. The experimental results show that the change of the density of nitrobenzene with temperature is linear. The measurements in the neighbourhood of 9.5° C. were made with special care. AUTHOR.

See also Abstracts 2677, 2759.

DIFFUSION AND OSMOSIS.

2712. Diffusion Constants of Proteins. A. Polson. *Kolloid Zeits.* 87. *pp.* 149–181, *May*, 1939.—In this paper, the refraction method of Lamm is described together with methods for the calculation of the diffusion constants from the curves. The employment of Lamm's method upon heterogeneous sols has made it possible to determine whether protein solutions are uniform or not with respect to size and form; the normal curve for a polydisperse system passes always through a point below the maximum of the polydisperse curve. The preparations of most of the proteins investigated are described, and the diffusion constants of 32 proteins have been determined for various concentrations and at different H-ion concentrations. A relationship has been indicated between alteration of diffusion constant with concentration and molecular weight; this change is greater for the proteins of smaller molecular weight. The sedimentation constants, specific particle volumes and molecular weights have been calculated from the diffusion constants. H. H. Ho.

2713. Colloido-Osmotic Pressure of Blood Serum. P. Meyer. *Comptes Rendus*, 208. *pp.* 1437–1439, *May* 1, 1939.—In blood serum the osmotic pressure increases more rapidly than the concentration. Three equations have been given by different authors to represent the relation of the colloido-osmotic pressure to the content of proteins. The measurements of the author are in conformity with Verney's equation: $p(v - b) = k$, where p is the colloido-osmotic pressure, v the inverse of the protein contents, and b and k are constants. G. E. A.

See also Abstract 2666.

ELASTICITY AND PLASTICITY.

2714. Compressibility of Liquids. P. Guareschi. *Accad. Lincei, Atti*, 29. *pp.* 61–69, *Jan.*–Feb., 1939.—A formula for the compressibility of a liquid is given which contains, besides the usual physical constants of the liquid, a "coefficient of association" and the average number of collisions per molecule per second. If these two quantities are substituted from semi-empirical formulæ derived by the author, the results are near to the experimental values. R. P.

2715. Elastic Strains in a Plate Containing a Hole with a Reinforced Edge. L. Sobrero. *Accad. Lincei, Atti*, 28. *pp.* 378–384, *Dec.*, 1938.—The problem is solved in general terms for a circular hole, with a rim of arbitrary cross-section, assuming only that its thickness is small compared to the radius of the hole. R. P.

2716. New Method of Calculating Stresses in Skyscraper Frameworks Subject to Horizontal Forces. M. Ballarin. *Ricerca Scientifica*, 10. *pp.* 301–317, *April*, 1939.—The method is applicable to a framework consisting of horizontal and vertical bars in which the number of horizontal bars is so large and their vertical distance so small that the variation of the stresses from one to the next can be neglected. In this case the difference equation representing the variation of stresses with height can be replaced by a differential equation and can be solved in this manner. R. P.

2717. Shear-Stress Systems and Combined Stress. J. J. Guest. *Phys. Soc., Proc.* 51. *pp.* 652–659, *July*, 1939.—This paper discusses an objection which has been raised to the law of elastic failure under combined stress [see Abstract 2128 (1900)], namely that, instead of the volumetric stress then used, the average volumetric stress should be employed and that only shear stresses should be associated with it. A resolution of a stress system into uniform tension and shearing stress, of a type which is advocated to-day and appears to offer advantages, is first discussed and is shown to be inapplicable as not being a complete representation. It is then pointed out that there are usually an indefinite number of shear-stress systems and only in certain cases are the shears unique. For the precise expression of a law of failure the indefiniteness must be removed, and the simple limitations available for the purpose are discussed and shown to be inapplicable. Finally it is shown that the adoption of the suggested scheme could only be applicable to such materials as have a failure limit in simple compression less than three times that in simple tension. Thus it is incompatible with a law of failure which is to be of general application. AUTHOR.

2718. Variation of Young's Modulus for Iron at Low Temperatures. M. Barbaron. *Comptes Rendus*, 208. *pp.* 1559–1561, *May* 15, 1939.—An arrangement was used to obtain a periodic variation of length by oscillations and so get cycles of extension as a function of stress. The extension could be measured to 0·5μ. A curve shows the relation of the ratio E_t/E_o to temperature down to nearly − 200° C., where E_t and E_o are Young's modulus at t° and o° C. respectively. There is a pronounced discontinuity at − 40° C. in the increase of the ratio E_t/E_o with fall of temperature. A hysteresis effect was found in the curve for heating and cooling but this disappeared after several cycles of temperature. R. S. R.

2719. Elastic Properties of Thin Quartz Fibres. O. Reinkober. *Phys. Zeits.* 40. *pp.* 385–386, *May* 15, 1939.—The author, in a previous paper [see Abstract 1505 (1937)] found that the elastic moduli of thin quartz fibres increased with decreasing diameter of the fibres, the increase being particularly marked in the case of fibres of diameters less than about 1·5μ. Jurkov, on the other hand, found values of Young's modulus for these fibres which were almost constant for all diameters and approximately the same as that found by Reinkober for very fine fibres. Jurkov contends that Reinkober's results are attributable to yielding of the support to which the fibres were attached. Reinkober repeating his own experiments, taking observations at both extremities of the fibres confirms his previous results. The graph of torsion modulus against thickness of fibre resembles the Young's modulus-thickness graph. Values of Poisson's ratio are found to range from 0·22 for fibres of diameter 80μ to approximately nil for the finest fibres, but owing to the degree of scattering shown by the experimental results, these values can only be accepted with caution. J. S. G. T.

2720. Determination of Elastic Constants by Pressure Method, and its Applications to NaCl Crystals. M. Kantola. *Soc. Scien. Fennica, Acta*, 3. 1. [61 *pp.*], 1939. *In German.*—After a discussion of the relevant general theory and of previous experimental determinations, a method is described in which the application of unidirectional pressure produces a change of length in a crystal prism. This contraction is measured by the resulting changes in the capacitances of three plate condensers arranged symmetrically around the axis of pressure, and having their opposite plates rigidly attached to the compressing surfaces between which the crystal is placed. With a suitable ultramicrometer circuit connected to the condensers, changes of length of 10^{-6} mm. are accurately measured. The method is applied to four NaCl crystals, which are subjected to a pressure of 5 kg./cm^2. Assuming Bridgman's value for the compressibility of NaCl, viz. :— $4\cdot26 \times 10^{-12}$ cm^2./dyne, the values $c_{11} = 4\cdot99 \times 10^{11}$ and $c_{12} = 1\cdot00 \times 10^{11}$ dyne/cm^2., are obtained for the elastic constants, in agreement with the results of Bridgman from flexure and torsion experiments. J. P. A.

2721. Photoelastic Method of Stress Analysis. R. D. Mindlin. *J. of Applied Physics*, 10. *pp.* 222–241, *April, and pp.* 273–294, *May*, 1939.—A comprehensive survey. Stress and strain are defined and their components explained. The propagation of light in isotropic and crystalline media is discussed theoretically and the question of stress-optical relations for two-dimensional photoelasticity is dealt with. Photoelastic materials are considered in detail; model making and loading machines are also discussed. A section is devoted to the measurement of the differences between principal stresses and between their directions; another section contains a full account of the independent determination of principal stresses by means of a number of methods such as Filon's, Neuber's, Fabry's, etc. Special developments and applications of photoelastic stress analysis are discussed and an extensive bibliography is added. This contains 181 references, mostly to work published since 1930. J. T.

2722. Graphical Analysis of Free Vibrations of Helical Springs. K. J. DeJuhasz. *Frank. Inst., J.* 227. *pp.* 647–672, *May,* 1939.—An illustrated mathematical study to determine the law of motion of a helical spring under an initial longitudinal strain when the external constraining forces are removed instantaneously. The method employed involves the construction of tri-dimensional "stereograms" from data relating to velocity $v = f_1(t, x)$, strain $s = f_2(t, x)$ and displacement $u = f_3(t, x)$ where x denotes all points of the spring and t represents time. The conditions studied are (1) spring without concentrated mass, (*a*) one end fixed and the other free, (*b*) both ends free, (*c*) both ends fixed; (2) spring with concentrated masses, (*d*) one end fixed and the other attached to a mass, (*e*) both ends free and attached to masses, and (*f*) both ends fixed, with a finite mass attached to the mid point. The method is applicable to such related phenomena as vibrations in liquid columns, gas columns and electric surges. S. A. S.

2723. Applications of Normal Coordinates to Engineering Vibration Systems. R. Eksergian. *Frank. Inst., J.* 227. *pp.* 673–690, *May,* 1939.—A paper on the elementary theory and application of normal coordinates to some simple torsional systems. The cases considered are (1) two mass torsion system with elastic coupling, (2) single reduction geared system, (3) flexible geared system, and (4) systems with damping. The treatment covers free and forced vibrations, calculation of stresses, and the effect of damping which introduces coupling between the modes of vibration. S. A. S.

2724. X-Ray Study of Changes in Malleable Iron During Process of Fatiguing. R. G. Spencer. *Phys. Rev.* 55. *pp.* 991–994, *June* 1, 1939. —Carefully prepared test bars of malleable iron have been fatigued; X-ray diffraction patterns were taken of each specimen at intervals as fatiguing progressed. This study shows that, when malleable iron is fatigued below its endurance limit, no changes in internal structure that are detectable by the camera used occur after the first few cycles. However, when malleable iron is fatigued above its endurance limit, marked changes do occur. Appreciable changes may occur during the first few cycles of fatiguing. Changes then take place comparatively slowly during the major part of the fatiguing process. These changes proceed at an accelerated rate as the specimen approaches failure. The changes consist of (1) rotation of some of the grains, (2) introduction of strains in some of them, and (3) fragmentation of some of the grains into sizes small enough so that they arrange themselves with random orientation. These changes are all readily detectable with the camera used. AUTHOR.

See also Abstracts 2680, 2787, 2868, 2947, 2958, 3060.

GRAVITATION.

2725. Gravity Oscillations at Mountain Edges during Melting of Snow. H. Lettau. *Gerlands Beitr. z. Geophys.* 54. 3. *pp.* 179–193, 1939. —A 3-weekly series of horizontal double-pendulum observations were made at Berchtesgaden. It was found that (1) at melting of the snow in March a systematic inclination of the N-S component of $0''\cdot16$ per day occurred in the sense of heaping to the south. With new snowfalls this decreased to 0″·1 per day but had a maximum at melting of 0″·2 per day. Provided this movement does not extend to the inner part of the mountains it is assumed that the adjoining High Goll (2522 m.) had given way up to 50% in the sense of isostatic layering under the snow load; (2) the maximum 24-hour change of inclination occurs at the start. This could be caused by micro-faulting limited by the transition from elastic to plastic deformation within the real layers of the rock; (3) the tidal movements of the gravity oscillations in the N-S component reaches 37 to 51% of the amount for rigid earth with the M_2 and S_2 waves. R. S. R.

2726. Gravity Measurements in Cyprus. C. Mace and E. C. Bullard. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp.* 473–480, *June*, 1939.—Gravity was determined by pendulum observations at 13 stations, and the free-air, Bouguer, isostatic and Heiskanen anomalies calculated. These are very large, a fact which is only very partially accounted for by the visible mass of the central mountains on any reasonable assumption as to their density, and would seem to imply absence of the granitic layer and direct connection between the surface basic igneous rock and those generally supposed to exist at a depth of some km. C. A. S.

HYDRODYNAMICS AND AERODYNAMICS.

***2727. Simple Gas-Circulating Device. J. Mengelis.** *Zeits. f. phys. Chem.* 184. *Abt. A.* 1. *pp.* 42–44, 1939.—A gas-circulating device is described. It is operated by air under pressure, or by suction, and is capable of maintaining in circulation about 100–150 cm³./min. The circulating gas is separated by Hg from the outside atmosphere. J. S. G. T.

See also Abstract 2890.

KINETIC THEORY OF MATTER.

2728. Kinetic Energy of Polyatomic Molecules. A. Sayvetz. *J. Chem. Phys.* 7. *pp.* 383–389, *June*, 1939.—The theory of rotating axes and polyatomic molecules is extended in a form applicable to linear and anomalous molecules. It is applied to a linear tetratomic molecule and to an anomalous ammonia-like molecule, to obtain, in each case, a Hamiltonian kinetic energy lacking first-order terms. A second-order perturbation calculation yields the energy of interaction between rotation and vibration for the linear molecule. The relationship to Howard's theory of ethane is also given [see Abstract 3122 (1937)]. AUTHOR.

See also Abstracts 2714, 2758, 2947, 2948, 3064, 3066.

LENGTH, AREA AND VOLUME.

***2729. Measurement of Extremely Small Angles of Rotation. G. Sladbei.** *Soc. Roumaine de Physique, Bull.* 39. 72. *pp.* 91–94, 1938. *In German.*—Experimental details are given of a method of measuring extremely small angles of rotation. Using an ordinary level, in which the movements of the bubble are observed by a simple optical method giving a magnification of 400, angular displacements of 0·2″ can be measured. H. B.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2730. Formulæ for Associated Legendre Functions of the First Kind. T. M. MacRobert. *Phil. Mag.* 27. *pp.* 703–705, *June*, 1939.—[See also Abstract 1476 (1936).]

2731. Wave-Motion for Sub-Infinite Domains. A. N. Lowan. *Phil. Mag.* **27.** *p.* 769, *June,* 1939.—A correction to the original. [See Abstract 965 (1939).]

2732. Dimensional Coherence Applied to Thermodynamical Units. E. Bodea. *Soc. Roumaine de Physique, Bull.* **39.** 72. *pp.* 79–89, 1938. *In English.*—Giorgi's MKSO coherent system of dimensional units is briefly discussed and a coherent dimensional unit of temperature in a system employing 3 fundamental units (MKS or CGS) is derived by attributing the dimensions of energy to temperature. Entropy then appears as a dimensionless member, and Boltzmann's constant (k) being a proportionality factor equal to unity, is eliminated from thermodynamic equations. J. S. G. T.

★2733. Machine for Rapid Summation of Fourier Series. C. A. Beevers. *Phys. Soc., Proc.* **51.** *pp.* 660–667, *July,* 1939.—The rapid summation of Fourier series is becoming a more and more urgent problem in X-ray crystallography. A machine is proposed in which the fundamental sine curve of any amplitude may be represented by a number of sets of impulses. A switch can arrange these sets of impulses to correspond to a wave of any wave-number, and the sets of impulses then go into counters. Successive operations of the generator and arranging-switch result in the addition of Fourier terms, the terms being added for all values of the variable at the same time. AUTHOR.

See also Abstracts **2722, 2723, 2736, 2885, 2981, 3041, 3047, 3048.**

MECHANICS, QUANTUM.

2734. Invariance of Quantised Field Equations. K. Fuchs. *Roy. Soc. Edinburgh, Proc.* **59.** 1. *pp.* 109–121, 1938–1939.—The invariance of quantum dynamics in the form developed by Heisenberg and Pauli [see Abstract 3262 (1929)] against all transformations allowed by the general theory of relativity is proved. AUTHOR.

2735. Wave Equations for Particles of Higher Spin. J. Roubaud-Valette. *Comptes Rendus,* **208.** *pp.* 1076–1078, *April* 3, 1939.—Wave equations are constructed for particles of which the spin is an arbitrary multiple of the electron spin. R. P.

2736. Integration of de Donder's Equation. G. Biben. *Comptes Rendus,* **208.** *pp.* 1486–1488, *May* 8, 1939.—de Donder has proposed a five-dimensional partial differential equation to represent particles without spin, the continuum having a Riemannian metric. A formal indication of the method of obtaining the elementary solution (in the sense of Hadamard) of this equation is given. G. C. McV.

2737. Geometrical Interpretation of Spin. J. Mariani. *Comptes Rendus,* **208.** *pp.* 1483–1485, *May* 8, 1939.—In the geometrical interpretation of the quantum properties of elementary particles by the use of an elliptic space to represent the " interior " of such a particle, it is proposed to use the cross-ratio definitions of angle and distance. In particular this definition of angle has periodic properties which can be interpreted as a geometrical representation of the spin of a particle. [See Abstract 2347 (1939).] G. C. McV.

2738. Principle of Duality and Representation of Elementary Particles. J. Mariani. *Comptes Rendus,* **208.** *pp.* 1630–1632, *May* 22, 1939.—The assumption is made that a particle can pass spontaneously from a representatiion in terms of coordinates to one in terms of momenta, the transformation from coordinates to momenta being due to Legendre.

It is also postulated that such a passage is the mathematical counterpart of the passage of the particle from a state of positive to one of negative energy with the emission of a photon. It is pointed out how these ideas overcome some of the difficulties of the infinite energies of particles.

G. C. McV.

2739. Dynamical Model for Heavy Particles. W. Scherrer. *Helv. Phys. Acta*, 12. 3. *pp.* 249–269, 1939. *In German.*—In considering a generalisation to many particles of the principle of the equivalence of mass and energy, and the theoretical variety of rest masses, the author deduces that there are two alternatives. Either these differences are attributable to velocities within a system composed of homogeneous particles, or it is necessary to postulate from the first a variable mass in dynamics. On the first assumption a satisfactory solution follows for the two-body problem of relativistic electrodynamics. This case cannot be excluded so long as such a solution does not apply. With this reservation the author proposes a model for the second case which may be of some interest since it illustrates the genesis of a heavy particle from two light ones and also shows the influence of high energies. Whether the model can be applied in practice is still doubtful.

G. O. B.

2740. New Proof of the H Theorem. O. Halpern and F. W. Doermann. *Phys. Rev.* 55. *pp.* 1077–1082, *June* 1, 1939.—Boltzmann's H theorem is here given a new proof based upon the properties of the probability coefficients that determine the transitions between different states of the total system or of any part of the system. The customary assumption is made that the frequency of these transitions is proportional to the population of the initial state, and the solutions of the equations determining statistical equilibrium are then fully discussed. These solutions either agree with those obtained directly with the aid of the principle of microscopic reversibility, or they divide into mutually independent and noncombining groups each of which in itself satisfies the principle of microscopic reversibility. The proof applies equally to Boltzmann, Bose and Fermi statistics. It involves a theorem concerning the rank of a matrix formed from coefficients appearing in the equations of equilibrium.

AUTHORS.

See also Abstracts 2672, 2728, 2731, 3004, 3006, 3010.

PHILOSOPHY OF SCIENTIFIC METHOD.

See Abstract 2741.

PRESSURE.

See Abstracts 2727, 2947.

RELATIVITY AND ETHER.

2741. Interpretation of the Michelson-Morley and Kennedy-Thorndike Experiments. H. Dingle. *Phil. Mag.* 27. *pp.* 693–702, *June*, 1939.—The basis of relativity, *viz.*, that absolute motion is undetectable, is expounded in the light of the work of Ives [see Abstracts 481 and 3964 (1938)] who criticises relativity on the grounds that it is " metaphysical." An analysis of Ives' own axioms which replace that of relativity, *viz.*, that the velocity of light is a constant c and that the lengths of material rods and the frequencies of clocks are reduced by a factor $(1 - v^2/c^2)^{\frac{1}{2}}$ when moving with velocity c, shows that they do not give an improved " explanation " of the Michelson-Morley experiment and cannot account for the Kennedy-Thorndike experiment at all. The fallacies underlying Ives' proofs of the existence of absolute simultaneity and of the ether are pointed out as well as the confusion of thought which underlies the so-called "clock-paradox" in special relativity. G. C. McV.

2742. Behaviour of an Interferometer in a Gravitational Field. H. E. Ives. *J.O.S.A.* 29. *pp.* 183–187, *May,* 1939.—It is arbitrarily postulated that the formulæ normally associated with the theory of special relativity, *e.g.*, the Fitzgerald contraction formula and that for change of clock rate, are still valid when the *constant* relative velocity of two observers is replaced by the *variable* velocity produced by the Newtonian gravitational attraction of a spherically symmetrical mass. It can then be shown that twice the length of the arm of an interferometer in motion in Euclidean space is given by an expression formally resembling that of the Schwarszchild metric of general relativity with, however, one of the spatial dimensions omitted. G. C. McV.

See also Abstracts 2766, 3004, 3005.

SOLUTION.

See Abstract 2706.

SURFACE PROPERTIES.

2743. Heats of Adsorption of Gases on Oxides of Manganese at Low Pressures and Room-Temperature. W. E. Garner and T. Ward. *Chem. Soc., J. pp.* 857–864, *May,* 1939.—The heats of formation of CO, CO_2, O_2 and H_2 on an oxide of manganese in various stages of reduction have been measured in a thermocouple calorimeter. It is shown that the heats of adsorption obtained are dependent on the degree of unsaturation of the surface. AUTHORS.

2744. Heat of Adsorption of Gases on Cr_2O_3 at Low Pressures and Room-Temperatures. D. A. Dowden and W. E. Garner. *Chem. Soc., J. pp.* 893–902, *May,* 1939.—Measurements of the heat of adsorption of CO, CO_2, H_2 and O_2 on Cr_2O_3 have been made at 18° for the oxide in an oxidised and in a reduced state. The absorbing surface was ten times larger for the reduced than for the oxidised substance. The heat measurements indicate that the adsorption on an oxide surface of CO or H_2 is a two-stage process, the first being the formation of carbonate or hydroxyl ions on the surface, together with some surface unsaturation, and the second the disappearance of the unsaturation. The unsaturation disappears very slowly after the adsorption of CO unless H_2 is present on the surface, and very quickly in the case of the adsorption of H_2. The heats of adsorption of O_2 depend on the degree of unsaturation of the surface. Attention is directed to the part which the mobility of the atoms of the adsorbent plays in the chemisorption of gases on chromic oxide. The results for chromic oxide are compared with those previously obtained for ZnO,Cr_2O_3 and for zinc oxide, and conclusions drawn as to the changes in adsorptive capacity which occur on mixing two oxides. AUTHORS.

***2745. Adsorption Calorimetry on Cr_2O_3 at − 183° C. R. A. Beebe.** *Am. Phil. Soc., Proc.* 81. 1. *pp.* 1–14, 1939.—The adsorption of a gas on a solid surface may be: (1) activated adsorption, or (2) van der Waals (physical) adsorption, and only the former of these is in general related to the catalytic activity of the adsorbent material. Because of the great difference in the characteristics of the energy changes occurring during the two types of adsorption, the calorimetric determination of the heats of adsorption provides useful evidence in deciding whether a given process belongs to the activated or the van der Waals type. A vacuum adsorption calorimeter is described which is designed to eliminate the troublesome experimental difficulties arising from the temperature gradients within the instrument. Heats of adsorption at − 183° C. have been measured calorimetrically using the six gases, A, H_2, D_2, CO, N_2 and O_2 on a reduced chromic oxide surface. The order of magnitude of the heats indicates that all these gases, with the single exception of A, are in part held in a state of activated adsorption as well as in the van der Waals state even at the low temperature of − 183° C. Moreover in the experiments with CO, N_2 and O_2, the complex form of the time-temperature curves on a partially covered surface has led to the conclusion that the adsorbed gas changes over *on the surface* from an initial van der Waals state to a final state of activated adsorption. AUTHOR.

2746. Electrolyte Adsorption and Activity Coefficient. Part I. Adsorption of Acids by Charcoal. Wo. Ostwald. *Kolloid Zeits.* **87.** *pp.* **128–149,** *May,* **1939.**—This series of papers continues previous work by the author [see Abstract 945 (1936)]. The adsorption of strong inorganic acids by charcoal is mathematically treated from the standpoint of activity coefficients calculated on the Debye-Hückel theory. It is found that the concentration function of the adsorption of strong acids obeys the simple linear relationship over a large concentrations range, $f_x^{\pm} = a \cdot f_{c-x}^{\pm} + b$, where $f_x^{\pm}$ and $f_{c-x}^{\pm}$ are the activity coefficients of the adsorbed solution of concentration x and equilibrium solution of concentration $c - x$, while a and b are constants. This equation is very thoroughly discussed and found in general to be valid for strong but not for weak acids, *e.g.*, acetic acid, and also to hold for adsorption at different temperatures. Extreme cases are found to require the more general equation, $-\log f_{c-x} = a \cdot 10^{-n\sqrt{\nu_{x+c}}}$. The plot of this equation has a middle linear section corresponding to the above linear equation. H. H. Ho.

2747. Adsorption of Acids by Synthetic Resins. G. Broughton and Y. N. Lee. *J. Phys. Chem.* **43.** *pp.* **737–741,** *June,* **1939.**—The rates of adsorption of H_2SO_4 and HCl by aniline and *m*-phenylenediamine resins have been determined. Unexpectedly low values for the equilibrium adsorption were obtained, indicating that condensation probably occurs through the amino groups as well as through the nucleus. AUTHORS.

2748. Surface Energy of Mixtures of Fine Powders and Paraffin. R. S. Bradley. *J. Phys. Chem.* **43.** *pp.* **663–669,** *May,* **1939.**—The rise in surface tension of a liquid due to the presence of fine particles of solid was explored. C, NiO and CuO of grain size about 5×10^{-5} cm. all gave considerable though different elevation of surface tension. MgO was ineffective. The phenomenon is dealt with theoretically on the basis of the author's previous work on attractive forces between spheres containing given numbers of molecules, and some support for the result is obtained in the case of C in paraffin, though the final expression for the elevation of the surface tension does not admit of evaluation. P. H. B.

2749. Surface Tension in Different States of Aggregation. G. Antonow. *Ann. d. Physik,* **35. 1.** *pp.* **84–96,** *May,* **1939.**—Antonow's rule, *viz.* $\gamma_{12} = \gamma_1 - \gamma_2$ (where γ_{12} is the interfacial tension between two phases, and γ_1, γ_2 are their respective surface tensions against the common vapour) is claimed to hold for any phase pair in equilibrium, and is therefore applied to the determination of the surface tension of *solids.* Thus, since $\gamma_{sl} = \gamma_s - \gamma_l$, by finding conditions where $\gamma_{sl} = 0$, γ_s can be calculated, for γ_l can be determined by the usual methods. The following procedures were adopted for attaining the condition $\gamma_{sl} = 0$: (1) of a series of aqueous solutions of isobutyric acid of steadily increasing concentration (and thus of diminishing γ_l) the one was found which either (*a*) just failed to run off the solid, or (*b*) just gave zero depression in a capillary tube coated internally with the solid; (2) pastes of varying γ consisting of an oil + pigment were successively run out of a tube made of the solid, till one just left no film behind. Method (1) applies where $\gamma_s < \gamma_{H_2O}$, (2) where $\gamma_s > \gamma_{H_2O}$. Using them the following values of γ_s were obtained (dyne/cm.): paraffin wax, 40; beeswax, 46; glass, 130; rock-salt, 300. S. J. G.

2750. Structure of Silver Films. O. Goche and H. Wilman. *Phys. Soc., Proc.* 51. *pp.* 625–651, *July*, 1939.—An electron-diffraction study of the structure of Ag films condensed *in vacuo* on rock-salt cleavage faces at about 200° C., and of the changes produced by heating these films *in vacuo*, has shown that the reflection and transmission patterns are in general agreement with Menzer's view of the twinned structure of such films. The films examined yielded patterns of a type indicating strong <111> extensions of the reciprocal-lattice intensity regions, but without marked development of [001] extensions. No conclusive evidence has been found of development of octahedral boundary faces of the films in addition to the twinning which occurs on these planes. The positions of the diffraction spots and lines in patterns from films which had become distorted during the dissolution of the substrate and the mounting of the film showed that parts of the film had become considerably curved about axes parallel to the cube axes and cube-face diagonal directions in the film plane. These types of curvature are in agreement with the form of the substrate surface and the twinned structure of the films. General equations are derived for use in considering the geometrical features of rotation patterns yielded by cubic crystals. Heating *in vacuo* at about 500° C. quickly converts the Ag films into normal relatively perfect single crystals in the same orientation as that part of the initial film whose lattice was parallel to that of the rock-salt substrate. Such an extensive atomic rearrangement testifies to a high mobility of the Ag atoms at temperatures much below the melting point; this has been inferred by previous investigators, but in this case is shown to occur within the lattice and not merely on its surface. AUTHORS.

2751. Built-Up Films of Unsaturated and Substituted Long-Chain Compounds. A. E. Alexander. *Chem. Soc. J. pp.* 777–781, *May*, 1939.—A number of long-chain compounds, particularly *cis-trans*-unsaturated and α-substituted acids, have been built up from monolayers on water into multilayers on polished Cr. The optical thickness per layer was compared with the spacing determined by X-rays. The results support previous findings that multilayers are microcrystalline and that the method is excellent for obtaining oriented crystals of long-chain compounds which may be difficult to crystallise in other ways. Some chemical reactions in multilayers have also been studied. AUTHOR.

2752. Transformations of Higher Orders in Monomolecular Films. D. Dervichian and M. Joly. *Comptes Rendus*, 208, *pp.* 1488–1489, *May* 8, 1939.—The discontinuities previously noted as well as others occur at definite molecular areas of the chains of the compounds concerned (*e.g.*, oleic or myristic acids, several triglycerides, etc.); these areas are also those which correspond with changes of phase indicated by sudden

change in superficial viscosity or electric moment. Thus 19·5 Å^2 is the area which corresponds with passage from the liquid crystal or expanded phase to the solid. Other examples are given. [See Abstract 996 (1938).]
C. A. S.

2753. Dynamic Birefringence Produced during Stretching of a Liquid Film. G. Duch. *Comptes Rendus*, 208. *pp.* 1571–1572, *May* 15, 1939.—Vertical liquid films are raised on a glass filament frame (Proctor Hall method) between crossed nicols whose principal sections make an angle of 45° with the direction of movement. At first, the whole film surface appears dark; but a light band then appears below, parallel to, and separated from the supporting filament. When the film is raised further, a second similar band appears above the junction of the film and the free surface of the liquid. It is suggested that the bands are at the positions of maximum tension in the films. For corrections see *ibid. pp.* 1880–1881, *June* 12, 1939. C. B. A.

2754. Study of Films at Liquid/Liquid Interface. Parts I and II. A. E. Alexander and T. Teorell. *Faraday Soc., Trans.* 35. *pp.* 727–737, *June*, 1939.—For Part I the methods available for the quantitative determination of the oil/water interfacial tension in the presence of an insoluble monolayer have been critically examined, in particular for the benzene/water system. Of the methods which seemed most suitable, namely the modified surface balance of Askew and Danielli, the Wilhelmy plate and the maximum pull on a ring, only the last was found to give accurate results over a sufficient range. In the experimental procedure finally adopted the area is kept constant to avoid leaks and the interfacial concentration is increased by repeated injections of the spreading material into the interface. Possible errors and the experimental accuracy have been examined and discussed. The changes in the electrical potential across the interface brought about by an insoluble monolayer can be measured by the ionisation method as at the air/water interface provided very thin layers (1–2 mm.) of benzene are used. In Part II force-area curves are given for two proteins (gliadin and serum albumin), lecithin, lysolecithin and sodium cetyl sulphate, at the benzene/water interface. At low pressures all films examined are very much more expanded than at the air/water interface but at high pressures approximate to the air/water interfacial values. The experimental curves were found to fit a hyperbolic equation of the type $(F - F_0)(A - A_0) = C$. Transition from the air/water to the oil/water interface practically removes the F_0 term but has little effect on A_0, thus confirming Langmuir's theory of expanded films. AUTHORS.

2755. Optical Thickness of the Transition Layer between Transparent Media. H. D. Bruce. *Roy. Soc., Proc.* 171*A*. *pp.* 411–420, *June* 6, 1939.—In view of the use that is being made in recent years of the properties of reflected plane polarised light to determine the nature and thickness of the adsorbed or transition layer, the theories of Drude and Maclaurin are discussed and found to reduce to an identical form not permitting of mathematical separation of thickness and refractive index of the transition layer, not even by the use of a series of observations as simultaneous equations. It is shown that the minimum thickness of the adsorbed layer compatible with the equations is derived by assuming the refractive index of the adsorbed layer to be the geometrical mean of the indices of the two media. AUTHOR.

2756. Spreading of Paraffin Oils Containing Fatty Acids on Aqueous Solutions of Ca-Ions. E. H. Mercer. *Phys. Soc., Proc.* 51.

pp. 561–565, *July*, 1939.—The spreading of drops of paraffin oil containing stearic acid on alkaline solutions of $CaCl_2$, during the course of which the acid molecules escape from the oil lens, is described. AUTHOR.

See also Abstracts 2761, 2887, 3025 and
1555B. Lubrication. Part V. M. Muskat and F. Morgan.
1556B. Thin Oil Films. W. Claypoole.

VISCOSITY AND FRICTION.

2757. Charts and Tables for Flow Produced by Steady Rotation of Elliptic Cylinder in Viscous Fluid. T. Sakurai. *Phys. Math. Soc. Japan, Bull.* 21. *pp.* 178–181, *April*, 1939. *In English.*—[See also Abstract 2379 (1939).]

2758. Viscosity of Gases. Parts I and II. S. Weber. *K. Onnes Lab. Leiden, Com. No.* 88*a*. *Physica*, 6. *pp.* 551–571, *June*, 1939. *In German.*—Van Itterbeek and Keesom have measured the viscosity of He at H_2 and He temperatures using the Maxwell Method [see Abstract 1878 (1938)]. They found the relation between viscosity and pressure to be of the form $\eta' = \eta_\infty(p_{cm}/(a\eta_\infty + p_{cm}))$. Part I of this paper gives a theoretical derivation of this formula, and is based on the work of Chapman ($\eta_\infty = 0{\cdot}499\ Nm\,\Omega\,\lambda_C$), Maxwell, and Knudsen's molecular pressure difference results. Good agreement is found between the experimental results given above and the derived results. Part II deals with the variation of viscosity with temperature, and first the existing work is reviewed. The formulae of Lennard-Jones and v. Hasse and Cook are considered in their relation to that of Sutherland and another derivation is given and is applied to data taken from current tables. E. H. D.

2759. Viscosity of Aqueous Solutions of Strong Electrolytes of Higher Valency Type. E. Asmus. *Ann. d. Physik*, 35. 1. *pp.* 1–22, *May*, 1939.—The viscosity of solutions of the salts $CuSO_4$, $ZnSO_4$, $MgSO_4$, $CdSO_4$, $MnSO_4$, $Cr_2(SO_4)_3$, $Ca_2Fe(CN)_6$ and $Ca_3[Fe(CN)_6]_2$ are measured, over a concentration range from 0·00006 to 0·01 molar. By extrapolation to infinite dilution certain limiting values are deduced which are in good agreement with those calculated by the theory of Falkenhagen. From the values of the apparent specific gravity s of the solutions, as determined in connection with the viscosity measurements, it appears that the quantity $(s-1)/\sqrt{c}$, where c is the concentration, is a linear function of $\sqrt{c}$.
L. A. W.

2760. Viscosity of Aqueous Solutions of Strong Electrolytes. Part IV. H. Tollert. *Zeits. f. phys. Chem.* 184. *Abt. A.* 2. *pp.* 150–158, 1939.—The viscosities of aqueous solutions of mixtures of NaCl and KCl, $MgCl_2$ and KCl, and $(NH_4)_2SO_4$ and $ZnSO_4$, of various compositions, have been determined in order to discover whether loose compounds of the constituents existed in aqueous solution. No such combination was detected with NaCl and KCl, but $MgCl_2\cdot KCl$, and $(NH_4)_2SO_4\cdot 2ZnSO_4$ were shown to be present in the other systems. The limits of the principle upon which the work is based are discussed. It is found that molecules of this type can only exist in aqueous solution if combination between the constituents is also maintained in the crystalline state, although the stoichiometric proportions in which the constituents combine may be different. [For Part III see Abstract 94 (1938).]
A. J. M.

2761. Friction and Lubrication. Part II. S. Erk. *Die Physik,* 7. 2. *pp.* 47–52, 1939.—Brief summaries are given of recent papers on "dry friction," *i.e.*, friction without lubrication, and on friction between partially and completely lubricated surfaces. [For Part I see Abstract 2429 (1935).] H. J. H. S.

2762. Nature of Sliding Friction. J. J. Bikerman and E. K. Rideal. *Phil. Mag.* 27. *pp.* 687–692, *June,* 1939.—If sliding friction is due to cohesion, "welding," or plastic flow, the value of the coefficient of friction must depend on the previous overloading of the surfaces in contact. As this after-effect cannot be detected for hard surfaces, the friction between hard surfaces cannot be due to the above-mentioned effects. On the other hand, Coulomb's theory ascribing friction to a lifting of the slider over irregularities finds a semi-quantitative confirmation in the absolute value of the coefficients of friction. AUTHORS.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2763. Durability of Aluminised Mirrors in Astronomical Use. R. C. Williams.** *Astrophys. J.* 89. *pp.* 611–622, *June,* 1939.—A survey has been made of the durability of mirror coatings of Al and Cr-Al used by astronomical observatories in the United States and Canada. Some general remarks are given concerning the deterioration of the coatings and their care and expected life. It is concluded that the most probable useful life of a coating of either of the films is from 2·5 to upward of 5 years, depending upon the excellence of the coating, its care, and the degree to which it is subjected to condensed moisture and dirt particles. AUTHOR.

***2764. Additions to Zeiss Planetarium. H. Raudenbusch.** *Naturwiss.* 27. *pp.* 383–386, *June* 2, 1939.—Two new devices for use in conjunction with the Zeiss projector are described. One shows the sun and the six inner planets as seen from outside the solar system. The other shows (exaggerated) the parallactic and aberration ellipses described by Sirius. The optical systems employed are given, together with views of the complete devices. A. HU.

See also Abstract 2778.

COSMOGONY.

2765. Earth Structure and Origin. K. F. Mather. *Science,* 89. *pp.* 65–70, *Jan.* 27, 1939.—The tidal and planetary theories of planetary origin are discussed. The records of earthquakes indicate that the earth has a stratiform structure, and this has made geologists, in general, sceptical of the planetesimal theory. The author considers the various strata at 60, 475·2900 km. for composition of earth material at these depths. He says that there is no unchallengeable identification, as yet announced, of a seismogram phase as due to a wave which has passed through the earth's core as a shear wave, and therefore he considers the core to be quasi-liquid. He accepts Chamberlain's later presentation of this theory, namely that the stratiform structure of an earth (originally heterogeneous, and always entirely crystalline) arose in part from the selective nature of accretive process and in part from the selective volcanism. The origin of folded mountains, he says, is favourable to the basic principles of the planetesimal theory. A. S. D. M.

2766. Normal Modes of Vibration in Cylindrical and Spherical Universes. P. O. Müller. *Phys. Zeits.* 40. *pp.* 366–384, *May* 15, 1939.—The author gives a number of coordinate-systems which can be used to describe a cylindrical (Einstein) or a spherical (de Sitter) universe. He then writes down the tensor equation which is the condition that the vectorial divergence of an undefined scalar function shall vanish. This equation is solved in detail in both the Einstein and the de Sitter universes, it being assumed that the solution is of the form $ve^{-2\pi i\nu t}$ in each case, where v is a function of the space-coordinates only and t is the time-coordinate. G. C. McV.

NEBULÆ.

2767. Physical Processes in Gaseous Nebulæ. Part VI. Equations of Radiative Transfer. L. H. Aller, J. G. Baker and D. H. Menzel. *Astrophys. J.* 89. *pp.* 587–593, *June*, 1939.—The general equations of transfer for bound-bound, bound-free, and free-free transitions for a hydrogenic nebula are derived from the usual macroscopic equations by the identification of the emissivity and absorptivity functions with those given in Paper I of this series [see Abstract 2998 (1937)]. The integration of these equations is reserved for another paper. [For Part V see Abstract 4836 (1938).] AUTHORS.

2768. Spectra of Two Reflection Nebulæ. J. L. Greenstein and L. G. Henyey. *Astrophys. J.* 89. *pp.* 647–652, *June*, 1939.—Spectra of the Orion nebula and of the Pleiades nebula have been obtained with the nebular spectrograph at the McDonald Observatory. The Orion nebula has a strong continuous reflection spectrum superposed over the bright-line spectrum. Spectrophotometric determinations of colour show that these nebulæ are slightly bluer than their illuminating stars. An interpretation of these results is given on the basis of our theoretical discussion of the colours of nebulæ. Estimates of the albedo of the scattering and absorbing particles are obtained. AUTHORS.

2769. Diffuse Nebulæ. J. L. Greenstein and L. G. Henyey. *Astrophys. J.* 89. *pp.* 653–658, *June*, 1939.—Emission-line intensities have been measured in the spectrum of the Orion nebula. The Balmer decrement agrees with the predicted values for an electron temperature near 5000°. The excessive strength found for Hα may arise from blending with the lines of [NII]. Measures of the continuous emission beyond the Balmer limit yield an electron temperature near 5000°. It is found that the lines of high excitation are concentrated at the centre of the nebula. The intensity of the continuous reflection spectrum in various parts of the nebula is observed to be closely correlated with the intensity of the emission lines. Photometry of nine diffuse nebulæ yields a slightly steeper Balmer decrement, while the faint nebulæ near γ Cygni display excessively strong Hα. A résumé is given of the spectra of other objects observed with the nebular spectrographs. AUTHORS.

PLANETS.

2770. Rotation of the Earth and Secular Accelerations of the Sun, Moon and Planets. H. Spencer Jones. *Roy. Astron. Soc., M.N.* 99. *pp.* 541–558, *May*, 1939.—The fluctuations in the mean longitudes of the sun, moon, Mercury and Venus are proportional to the respective mean motions of these bodies and can be attributed to variations in the rotation of the earth, caused by changes in its moment of inertia. The secular accelerations of the sun, Mercury and Venus are proportional to their mean motions and can be accounted for by retardation of the earth's rotation by tidal friction. The secular acceleration of the moon cannot be predicted theoretically, because tidal friction causes changes in the orbit of the moon that are too small to be determined by observation. The observations of the sun and of Mercury agree in indicating that the average effects of tidal friction during the past 250 years are smaller than the average effects during the past 2000 years. There is no indication of any large or sudden change. Corrections to the mean longitudes of the sun, Mercury and Venus, involving the fluctuation of the moon's longitude, are derived. These expressions can be used for the accurate prediction of eclipses and transits of Mercury and Venus, when the tabular error of the moon's longitude is known. AUTHOR.

2771. Total Lunar Eclipse of 7 Nov., 1938. F. Link and V. Guth. *Zeits. f. Astrophysik*, 18. 3. *pp.* 207–240, 1939.—The distribution of brightness in the earth's shadow during the eclipse is measured by methods of photographic photometry at an effective wave-length of 5800 Å. Exposures were made with an *f*/4·5 Cooke triplet, the photometric scale being printed with a tube sensitometer. Plates were secured out of eclipse, with the moon in penumbra, during the partial phase just before and just after totality, and during totality. On the partial-phase plates the bright crescent was screened by means of a filter. Some 2400 density measurements were subsequently made with a microphotometer. Variations of density with time at a given point in the shadow are attributed to the earth's rotation bringing different portions of its atmosphere to the terminators. Variations with position angle are attributed to variable meteorological conditions along the terminators. A. HU.

See also Abstracts 2764, 2765, 2806, 2811.

STARS.

2772. Determination of Absolute Brightness of O Stars from Interstellar Coloration. W. Becker. *Zeits. f. Astrophysik*, 18. 2. *pp.* 94–97, 1939.—A previously explained method, based on the relation between colour excess and distance of a star [see Abstracts 1978 and 1979 (1939)] is applied to determination of the absolute visual brightness of O-stars. The mean value from observation of 17 O-stars is $-3^{m}\cdot52 \pm 0^{m}\cdot13$. J. E. K.

2773. Scale of Potsdam Durchmusterung. O. Günther. *Zeits. f. Astrophysik*, 18. 3. *pp.* 212–240, 1939.—The Hopmann visual photometer, used in conjunction with colour filters, can be made to yield a system of magnitudes of constant effective wave-length, and colour indices of small range which, though they are of little use as temperature measures, can provide a homogeneous colour system. Measurements with the instrument are applied to the independent verification of the PD scale of magnitudes; 100 stars were observed with the photometer (the constants of whose Pt filters were newly determined for the purpose) in conjunction with a yellow filter. Colour indices derived from these measures and similar ones made through a blue filter were used to evaluate the colour equation of the apparatus. Blue and yellow light curves are given for the Cepheids α UMi, ζ Gem, and η Aql. The reality of the progressive changes of magnitude (" photometric proper-motions ") found by Zinner in certain stars is tested by comparison with early observations, but the results are uncertain. A. Hu.

2774. Spectrophotometric Study of Magnitude Scales. M. R. Hunt. *Harvard Coll. Obs., Bull. No.* 910. *pp.* 18–25, *March* 1, 1939.—It is pointed out that the recent development of aluminising mirrors may affect magnitude scales. A study is therefore made of the inter-relation of the photographic magnitude systems of a long-silvered mirror, a newly-silvered mirror, and an aluminised one. Plates centred on the Pleiades were taken with the 24-in. Oak Ridge reflector, with these 3 surfaces in turn, in conjunction with a 3° objective prism. From the energy curves so obtained, corrected for the absorption of the prism, measures of the photographic magnitudes of the stars were derived. Relative to new Ag, a reddening of about 0·2 mag. is found for old Ag, when B5 stars are compared with A5, whereas for Al the figure is − 0·5 mag. Increased sensitivity in the u.v. increases the uncertainty in extinction corrections, hence Al magnitudes are liable to greater errors. A table gives data from which corrections may be derived to give monochromatic magnitudes at 4700, 4430, 4200, and 4026 Å. A. Hu.

2775. Relation between Stream and Ellipsoidal Constants. W. M. Smart. *Roy. Astron. Soc., M.N.* 99. *pp.* 561–566, *May*, 1939.—The paper deals with the connection between the stream constants and the ellipsoidal constants. With Eddington's values of the stream constants obtained from his analysis of the proper motions of the Boss stars, the ratio of the minor axis to the major axis of the velocity ellipsoid and the longitude of the vertex are found to be 0·650 and 339°·0. A comparison between the results deduced from these values and the results of an analysis based on radial velocities is given. [See also Abstract 1032 (1939).] Author.

2776. Colorimetric Examination of Stars. K. Graff. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 9–10. *pp.* 449–496, 1938.—The author extends his previous work on visual star colours [see Abstract 5254 (1937)] to include stars down to mag. 6·5 between − 10° and + 20° dec. The measurements and form of publication of the results are as before. Heavy colour excesses in the O to B5 stars near the Milky Way are attributed to general selective absorption in the Galaxy rather than to an intrinsic effect. A relation is derived between spectral type and measured colour; the scale of colours is contracted between O and B3 and from K5 to M4. An empirical relation is also given between colour and absolute temperature, assuming 21,000° for a B0 star and 6000° for a G0. The measured colours correlate linearly with Seares's colour index between B8 and K4. A. Hu.

2777. Stellar Absorption Lines. D. H. Menzel. *Popular Astron.* 47. *pp.* 1–46, *Jan.–Feb.–March*, 1939.—The author reviews the work which has been done in the past 15 years on the theory of absorption lines in stellar spectra, but lays as little emphasis as possible on the mathematical side of the problem. He explains rather the physical processes operative in stellar atmospheres, though the various fundamental equations are given. The problem is attacked under the following heads: line absorption; general absorption; atmospheric models; transfer of radiation; the

stellar continuum; profiles of absorption lines; curves of growth; maxima of spectral lines as a function of temperature and pressure; chemical composition; miscellaneous difficulties and outstanding problems.
A. Hu.

*2778. **Interferometry in Stellar Spectroscopy. J. Dufay and J. Gauzit.** *Comptes Rendus*, 208. *pp*. 1481–1483, *May* 8, 1939.—A converging lens of a few decimetres focal length is placed behind the focus of an astronomical telescope so as to produce a narrower pencil of parallel light from the star. This beam is fed into a slitless spectrograph between whose prism and objective are a cylindrical lens and a Fabry-Perot etalon. When the etalon is slightly inclined, the spectrum lines become chords of interference fringes, each line of length 8 mm. cutting 3 or 4 fringes. The effect is to produce, in a cheap and handy form, a means of obtaining great dispersion (2 to 4 Å/mm. along the lines) without losing light. The apparatus has been used for measuring the widths of the Balmer lines in γ Cass, and of other absorption lines in B2–M0 stars. The widths correlate with intensity along the spectral sequence. It has also been employed in absolute measures of wave-length, the accuracy attained being of the order of a few hundredths of 1 Å, sufficient for radial velocity work with an objective prism.
A. Hu.

2779. **Spectrum of ξ Tauri. L. Biermann and O. Hachenberg.** *Zeits. f. Astrophysik*, 18. 2. *pp*. 89–93, 1939.—Struve and Wurm [see Abstract 3150 (1938)] observed that all the lines of He in the spectrum of ξ Tauri are strongly rotation-broadened except λ3965 and explained this phenomenon as a direct consequence of the latter originating from a metastable level. The contours of two further lines λλ5016 and 3889 from He metastable levels are investigated; the latter is generally found to be sharp but the former, as well as λ3965, is sharp on some plates and considerably broadened on others. In general the results are deemed a confirmation of Struve and Wurm's theory of the phenomenon.
J. E. K.

2780. **Equivalent Widths of He Lines in Early-Type Stars. L. Goldberg.** *Astrophys. J.* 89. *pp*. 623–646, *June*, 1939.—Curves of growth for the He lines are constructed for 57 O- and B-type stars and compared with a theoretical curve for He atoms at a temperature of 20000°. A study is made of the changes in the most probable value of the kinetic velocity of He atoms engendered by differences in temperature, turbulence, and/or Stark effect. Results indicate that turbulence depends rather strongly on temperature, and hence that radiation pressure may be one of the forces responsible for turbulence in stellar atmospheres. Curves of growth constructed from the observed widths of OII and NII lines in the B stars indicate large turbulent velocities in the supergiant atmospheres. The number of two-quantum He atoms per cm^2. above the photosphere, calculated for the O and B stars, is a maximum at class B4. The apparently anomalous widening of the singlet, as compared with the triplet, lines is found to be naturally accounted for without recourse to Struve's attribution of departure from thermodynamical equilibrium. Study of the forbidden line λ4470 and the permitted line λ4472 in the spectrum of γ Pegasi leads to a value of the field strength in agreement with Struve's estimate, and in accord with an electron pressure of the order of 10^{-4} atm.
E. M. W.

2781. **Origin of Unidentified Interstellar Absorption Lines. P. Swings and Y. Öhman.** *Observatory*, 62. *pp*. 150–152, *June*, 1939.—The probable origin of new interstellar lines from small solid particles is discussed in general terms. Experimental research is called for in the absorption spectra of the amorphous metals. If interstellar space contain amorphous and crystalline metallic particles, some processes associated with these are suggested as of possible application to the bright line nebulae and to the surface temperatures of O-type stars. E. M. W.

2782. Temperatures of Secondary Components in Eclipsing Binary Systems. Z. Kopal. *Astrophys. J.* 89. *pp.* 594–603, *June*, 1939.—The temperatures of the secondaries in eclipsing systems have been studied on the basis of their spectra and surface intensities. The main results are: (1) The temperatures of the secondaries are normal dwarf temperatures, agreeing very well with Kuiper's recent temperature scale. (2) The discrepancy between the ionisation and surface temperatures in systems displaying partial eclipses can, qualitatively at least, be explained by the ionising effect of the diluted radiation of the primary. (3) There appears to be no relationship between the difference in spectral type and the separation of the components or their mass-ratio. (4) The black-body radiation law would seem to be fulfilled conclusively even for B-type stars. AUTHOR.

2783. Ursa Major Cluster. R. Bartholeyns. *Comptes Rendus*, 208. *pp.* 259–260, *Jan.* 23, *and p.* 1556, *May* 15, 1939.—The method of Schloss [see Abstract 1100 (1936)] is applied to the Ursa Major moving cluster. Discrimination elements are given for 17 stars (first list) with Lick radial velocities, and 11 stars (second list) for which more recent radial velocities are available. A. Hu.

2784. Darkening at the Limb in Eclipsing Binaries. Part I. K. Ferrari. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 9–10. *pp.* 497–512, 1938.—Russell's 3-place tables connecting radii-ratio, phase, and light-loss in eclipsing binaries are no longer accurate enough for modern use in calculating orbits. The paper derives 4-place tables for the case of a large star of radius R eclipsing a smaller one of unit radius totally darkened at the limb in accordance with the law $h = 3\sqrt{1-x^2}/2\pi$, (h = surface brightness at a point x from the centre). The light-loss in units of the total light of the eclipsed component is tabulated with arguments $1/R$ and $(D - R)$, where D is the distance between the centres of the star discs. A. Hu.

2785. Axial Rotation in Eclipsing Binaries. Z. Kopal. *Harvard Coll. Obs., Bull. No.* 910. *pp.* 25–29, *March* 1, 1939.—Accurate spectroscopic observation of axial rotation in the components of close binaries is confined to certain bright systems; line-profile work, though applicable to fainter systems, is apt to be invalidated by other effects. The author points out that much information can be obtained from a study of tidal distortion, which is a maximum for synchronous rotation and revolution, and can be calculated from the mass-ratio, the radii-ratio, and the degree of central condensation of the components. Seven cases are cited in which the observed ellipticities are smaller than the minimum allowable on the basis of Roche's model. The deduction is made that the components rotate faster than they revolve. Such cases are to be regarded as exceptional in this respect though not necessarily in any other. Wide differences in the separation of the components suggest that there may be two classes of binaries, differing in the proportion of their total angular momentum stored as rotational momentum. A. Hu.

2786. Twelve New Southern Variables. J. B. G. Turner. *Roy. Astron. Soc., M.N.* 99. *pp.* 569–574, *May*, 1939.

2787. Stellar Variability and Relaxation Oscillations. A. J. Wesselink. *Astrophys. J.* 89. *pp.* 659–668, *June*, 1939.—A phenomenological theory of stellar variability is given. The first part of the paper discusses the different types of maintained oscillations possible in physical systems. Three groups are found: the sinusoidal type, the pure relaxation oscillation, and the induced relaxation oscillation. The second part examines the properties of the light-curves of variable stars. The current theory of Cepheid pulsation assumes the oscillations to be of the sinusoidal type and is unable to explain very skew light-curves or irregularities in period. The pure relaxation oscillations fully account for such irregularities as are shown, for example, by the SS Cygni stars and the long-period variables, whereas the regular variables are interpreted as possessing induced relaxation oscillations. For such variables the period-density law will remain valid, but the light-curves may be skew. AUTHOR.

2788. Photoelectric Observations of ϕ Persei. F. E. Roach. *Astrophys. J.* 89. *pp.* 669–672, *June*, 1939.—Observations of ϕ Persei during the latter part of 1938 do not indicate an eclipse during the abnormal spectroscopic phase, although the star appears to vary in an irregular manner. Changes in the star's colour are recorded. AUTHOR.

See also Abstracts 2772, 2896.

SUN.

2789. Photometry of Solar Granules. P. C. Keenan. *Astrophys. J.* 89. *pp.* 604–610, *June*, 1939.—Photometric measures of the solar photograph of July 10, 1937, were reduced with the aid of a correction for the spreading of the image, derived from the profiles of the finest markings visible. The largest distinct granules had a corrected diameter of 1″·4 and are 15% brighter than the background matter visible between them. The data for the average bright granules recognisable under favourable observing conditions are much less certain, but the most probable values for their dimensions are 1″·0 to 1″·2, and for the ratio of granular to background intensity, between 1·15 and 1·20. AUTHOR.

2790. Eruptions and Sunspots. R. G. Giovanelli. *Astrophys. J.* 89. *pp.* 555–567, *June*, 1939.—A preliminary examination is made of the statistical relationships between sunspots and solar eruptions. The analysis deals with the probability of an eruption in relation to the size, type, and development of the associated spot group. AUTHOR.

2791. Representation of Sunspot Cycle. C. N. Anderson. *Bell System Techn. J.* 18. *pp.* 292–299, *April*, 1939. *Terr. Mag.* 44. *pp.* 175–179, *June*, 1939. A paper analysing the components of sunspot data and giving a curve representing the variation in sunspot numbers from 1749 to date, which also is considered to be consistent with times of maxima and minima from 1610 to 1749. S. A. S.

2792. Hydrogen Emission near Limit of Balmer Series in Solar Chromosphere. S. Miyamoto. *Kyoto Coll. Sci., Mem.* 22. *pp.* 1–11, *Jan.*, 1939. *In English.*—It has been shown that in the solar chromosphere the H atoms in high energy levels are strongly affected by the outer influence due to the existence of other atoms and electrons and that their populations follow Boltzmann's law as the free electrons do, so that the capture theory is adequate to determine the population only for the states of small quantum number, which are under the complete control of the nuclear force. In order to characterise the outer influence, a criterion R_n has been defined as the ratio of the frequencies of collisional ionisation S_n and of the spontaneous transition A_n in state n, and has been given as a function of electron density. With this criterion the chromospheric observation has been discussed. The results are as follows: (i) R_n varies considerably with height in the chromosphere. (ii) At the height of 1000 km., where detailed observations have been made, the author's criterion seems to give the right order of figures. [See Abstract 1998 (1937).] **Author.**

See also Abstracts 2736, 2770, 2821, 2847.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

2793. Relations of Vertical Stability of Salinity and Oxygen Extremes in the Atlantic. R. B. Montgomery. *Gerlands Beitr. z. Geophys.* 54. 3. *pp.* 194–202, 1939. *In English.*—Converging surface water sinks along surfaces of constant potential density, so that potential density layers reaching the sea surface in regions of strong convergence may be expected to be thicker (less stable) than those reaching the surface in regions of weak or negative convergence. This effect is investigated with the aid of Schubert's stability values for the stations of the "Meteor" Atlantic Expedition. The results are tabulated and illustrated by graphs for the region 20° N. to 60° S. In certain cases the layers of relatively low stability can be attributed to strong convergence at their intersection with the surface. The same layers have high oxygen content, which substantiates the supposition that they are strongly supplied with water from the surface. R. S. R.

2794. Oscillation of Lake Water Generated by Wind Action. T. Takegami. *Kyoto Coll. Sci., Mem.* 21. *pp.* 233–245, *Nov.*, 1938. *In English.*—The writer reports mathematical investigations for the oscillation of lake water produced by wind action. For form of basin he has considered the circle, the concentric circles, the sector and the fan-shape. The method adopted may be described as follows: (1) the cylindrical coordinate is used; (2) it is assumed tha the bottom of the lake is smooth; (3) it is assumed that the inertia terms and the horizontal convective terms are negligible; (4) introducing the differential equation which determines the surface elevation, and is analogous to the differential equation for the oscillation of circular membrane in acoustics, he has solved it under the appropriate conditions. The equation obtained is

$$\frac{\partial^2\zeta}{\partial t^2}=\frac{\partial}{\partial r}\left(c^2\frac{\partial\zeta}{\partial r}\right)+\frac{c^2}{r}\frac{\partial\zeta}{\partial r}+\frac{1}{r^2}\frac{\partial}{\partial\theta}\left(c^2\frac{\partial\zeta}{\partial\theta}\right)-\frac{1}{r}\frac{\partial}{\partial r}(r\mathrm{T}_r)-\frac{1}{r}\frac{\partial\mathrm{T}_\theta}{\partial\theta},$$

where ζ is the surface elevation from the undisturbed surface, r and θ are the radial and the angular coordinate, $c^2 = gh$ (h being depth of lake), and T_r and T_θ are respectively the radial and the tangential components of wind action. **Author.**

See also Abstract 2808.

LAND, PHYSICS OF THE.

2795. Temperatures within the Earth. E. C. Bullard. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 534–536, *June,* 1939.—The assumptions made and the expressions obtained for the temperature below the radioactive layer by Jeffreys are quoted. The author obtains an expression for the temperature in a form in which its properties are more easily seen and results are tabulated. For radioactivity to produce a substantial increase in temperature it is necessary for the centroid of the distribution to be at least 10 km. down. Values tabulated show that radioactivity has little effect on the temperatures below 200 km. It is considered that determinations of the thermal conductivity of olivine and similar rocks should be made at high temperatures since this quantity is the most uncertain factor in the temperature in the absence or presence of radioactivity. R. S. R.

2796. Volcanism and Nuclear Chemistry. J. Noetzlin. *Comptes Rendus*, 208. *pp*. 1662–1664, *May* 22, 1939.—The author elaborates his theory by calculating the results to be expected on various assumptions as to the relations between the cross-sections of the neutron-producing and neutron-absorbing nuclei present. [See Abstract 2437 (1939).]
C. A. S.

2797. Intercalibration and Comparison of Measurements of Geological Ages of Rocks. Robley D. Evans, C. Goodman, N. B. Keevil, A. C. Lane and W. D. Urry. *Phys. Rev.* 55. *pp*. 931–946, *May* 15, 1939.—In an effort to extend the scope of geological age measurements based on the accumulation of He in igneous rocks, researches were initiated which indicated disagreement when compared with previously published results from the same geological horizons. Cooperative investigations, undertaken by the authors, show that the Ra determinations used in formulating the previous He time scale are incorrect by more than a factor of two. The magnitude of the necessary downward revision of ages varies, depending upon the Th/U ratio of the individual rock specimens. He age determinations have been made on a number of igneous rocks by two entirely different techniques, the α-He method and the Rn-Th-He method. The α-He method is independent of radioactive standards, and its results are in agreement with the new measurements by the Rn-Th-He method. These researches also represent the first comparison of He age measurements on the same specimens by two or more observers. While the He ages of many individual geological horizons are lowered by these new results, the total span of geological time remains unreduced. Precision Ra standards in the region of 10^{-12} gm. have been verified. AUTHORS.

2798. X-Ray Investigation of Soils. J. C. L. Favejee. *Zeits. f. Krist.* 101. 3. *pp*. 259–270, 1939.—The relation between the amounts of each constituent present in a mixture and the strength of the lines due to each may be directly linear (*e.g.*, for kaolinite and montmorillonite), but is more usually not so (*e.g.*, quartz, muscovite, etc.); the relation may also vary for different lines of the same substance. The compositions of 15 Dutch soils, mostly clays, as deduced from a comparison of X-ray observations of the soils with those of similar artificial mixtures of known composition are given illustrating the above. The figures also indicate that the totals so obtained for the soils always show a deficit; this is not due to the presence of amorphous material in the soils, but to the fact that the particles, or at least a substantial part of them are smaller than those in the artificial mixtures. [See Abstract 1569 (1939).] C. A. S.

2799. Analysis of Tilt Records at Bidston. R. H. Corkan. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp*. 481–497, *June*, 1939.—The recording mechanism of a Milne-Shaw seismograph was modified so as to be suitable for tilt registration and the clock was replaced by a synchronous electric motor. The observations for 12 months (1935–6) were harmonically analysed and the load tilt separated from the body tilt. This separation determines and is independent of the phase lag of the load tilt and thus eliminates the secondary effects of the oceanic tides. Comparison between the observed and the theoretical semi-diurnal body tilt gave a value for the yielding of the earth midway between the determinations by Michelson and Gale and by Schweydar. The response of the quarter-diurnal load tilt to the loading tide agrees with the response of the semi-diurnal load tilt. The 1933 diurnal tilt constants implied a body tilt not following the equilibrium law. Examination of these constants indicates that several years' observations are required before forming definite conclusions concerning the diurnal tilt. There is no evidence of appreciable permanent tilting of the ground at Bidston but the existence is shown of large oscillations of tilt which appear to be partly related to oscillations of atmospheric pressure. R. S. R.

METEOROLOGY.

2800. Upper Air Investigations in North-West Greenland. H. Carmichael and E. G. Dymond. *Roy. Soc., Proc.* 171*A*. *pp.* 345–359, *June* 6, 1939.—The winds of the coast of North-West Greenland have been investigated during summer 1937, and a meteorograph sounding to a height of 19·5 km. has been made in latitude of 76° N. Large balloons were used as pilots and their rate of ascent was determined directly by double theodolite observations. The average bursting height of the balloons was 24·5 km. The meteorograph revealed a well-marked tropopause at 11·2 km. and an unusual rise of temperature in the stratosphere. The pilot balloons showed very still air in the stratosphere throughout the summer and a marked velocity maximum at 9 km. in the troposphere. AUTHORS.

2801. Distribution of Ozone in the Stratosphere. W. W. Coblentz and R. Stair. *Bureau of Standards, J. of Research*, 22. *pp.* 573–606, *May*, 1939.—Measurements of the spectral quality and total intensity of u.v. solar radiation at a fixed ground station and at various elevations above the earth's surface are described. For making measurements at a fixed ground station at a high elevation (Flagstaff, Ariz., elevation 2·2 km.) a portable u.v. intensity meter, consisting of a balanced amplifier, Ti-photoelectric cell, and microammeter was used [see Abstract 1119 (1934)]. For measuring solar radiation in the stratosphere, an u.v.-intensity meter (consisting of a Cd-photoelectric cell and filter radiometer, connected with a balanced amplifier, relaxation oscillator, and radio transmitter) and a radio-operated barometer were transported aloft by means of unmanned balloons. The audio-frequency modulated radio wave, giving the intensity of the u.v. solar radiation and the altitude of the apparatus, was received and graphically recorded at a fixed ground station [see Abstract 1079 (1938)]. In the measurements at Flagstaff, Ariz., a close parallelism was observed in the variation in filter transmission with variation in barometric pressure. This is in agreement with the well-known variation in the amount of atmospheric ozone that accompanies changes in air pressure. No such systematic variation in filter transmission with variation in pressure of atmospheric aqueous vapour was observed. A notable example is described in which the wave of low barometric pressure preceded, by 5 to 6 hrs., an appreciable increase in atmospheric ozone; apparently indicating which was cause and which was effect, and suggesting a method of studying air circulation in the stratosphere. In four balloon ascensions made in June, 1938, the photoelectric u.v. intensity meter and auxiliary radio-transmitting apparatus attained heights of 83000 to 88000 ft. (25 to 27 km.), penetrating about 65% of the ozone, the most of which was localised in a layer extending from an elevation of 18 to 27 km., with a wide maximum of concentration at a height of about 25 km. At the highest elevation attained by the instruments, the intensity of the u.v. of short wave-lengths was about 10 times that of direct sunlight at sea level. AUTHORS.

2802. Effect of Solar Radiation on Mean Temperature of Atmospheric Ozone. A. Vassy and E. Vassy. *Comptes Rendus*, 208. *pp.* 1518–1520, *May* 8, 1939.—While Barbier and Chalonge in their investigation [see Abstract 2443 (1939)] considered Bouguer's method unsuitable for finding the mean temperatures of atmospheric O_3 the present authors favour it and state the advantages they think it possesses. They also deal with the possibility of differences of day and night temperatures and conclude from their observations (1) that within the precision of measurement the values cannot be regarded as different; (2) that the variations are of the order of those connected with daily changes in the masses of stratospheric air. Attention is also drawn to the change occurring during the long polar night and they consider that the variation found there appears to indicate a very definite influence from the prolonged absence of solar radiation on the mean temperature of O_3. A. E. M. G.

2803. New Experimental Proof of Rise of Temperature in Upper Stratosphere. A. Vassy and E. Vassy. *Comptes Rendus*, 208. *pp.* 1664–1666, *May* 22, 1939.—After referring first to the layer which causes diffusion of light from the sun to the zenith, of which the height can be shown to increase with zenithal distance of the sun, the authors point out that for light strongly absorbed by O_3 the diffusing layer is above the O_3 layer while for light not absorbed it is below. To test whether this rise in the diffusing layer causes a variation in the temperature of the O_3 bands, observations were made on light diffused to the zenith with the sun at zenith distances from 80° to 95°. A curve is drawn with absorption coefficients as abscissae and relative brightness of the sky as ordinates. Now from previous work [see Abstract 585 (1937)] it is known that the difference in absorption between a maximum and a neighbouring minimum is a linear function of the O_3 thickness and of the temperature. As the points on the graph do not lie on a straight line but depart from it in the sense corresponding to increasing temperatures, the authors consider that they have been able to show by this new method, a rise in temperature in the upper stratosphere. A. E. M. G.

2804. Variations of Effective Nocturnal Radiations on Clear Nights. J. Debrach. *Comptes Rendus*, 208. *pp.* 1524–1525, *May* 8, 1939.—The results discussed were got from observations carried out in 1931–32 near Paris, continuous registration of the radiation being obtained. It is found that on clear nights the effective nocturnal radiation decreases regularly right up to dawn. The variation of meteorological elements observed near the ground are unable, in the author's opinion, to explain entirely this diminution of effective radiation from dusk to dawn, but an explanation may be got in the considerable variation of temperature which occurs in a vertical direction in the course of the night. This interpretation is tested by observations of temperatures made at the Eiffel Tower, the results being given in tabular form. A. E. M. G.

2805. New Theory of Lapse-Rate. D. S. Subrahmanyam. *Indian Journ. Phys.* 13. *pp.* 43–55, *Feb.*, 1939.—A new type of vertical motion of air different from penetrative convection is discussed. For small vertical displacements the motion is assumed to be similar to that in long gravitational waves, the volume of an element remaining constant during the displacement. Vertical motion of this type is the result of differences of pressure set up in the vertical direction and the pressures on an element in the other principal directions do not alter during the process of small displacement. As a result of the change in pressure, the molecular energy of the element is altered. This results in a change of temperature, and consequently in a lapse-rate. There is close agreement between the value of the lapse-rate deduced for small displacements without acceleration and the mean lapse-rates in the free atmosphere observed at different stations under normal conditions, so that the theory of mass motion developed may be taken to be a true picture of what is happening in the free atmosphere. If the type of motion described here can be called cumulative convection, the free atmosphere may be said to be normally in "cumulative equilibrium." An explanation is also obtained for the ascent of air masses in a cyclone and their descent in an anticyclone. These movements are due to gradients of pressure in the vertical direction and the condition for motion is that when the lapse-rate is greater than the equilibrium rate, the acceleration is upwards, and when it is less than that, it is downwards. AUTHOR.

2806. Lunar Atmospheric Pressure Variations at Glasgow. R. A. Robb and T. R. Tannahill. *Roy. Soc. Edinburgh, Proc.* 59. 1. *pp.* 81–90, 1939.—An investigation has been made of the lunar inequalities from the Glasgow barograph records 1868–1912. It is shown that abnormal first and second harmonics exist in the inequalities obtained from barometrically quiet days, in addition to the non-periodic convexity effect. A provisional value of the normal lunar tide has been derived, which, for the total period of 45 years, has the value $0{\cdot}0110 \sin (2\theta + 60°)$ millibar, θ being reckoned from upper lunar transit. [See also Abstract 3809 (1935).] AUTHORS.

2807. Depressions as Vortices. A. H. R. Goldie. *Meteorolog. Office, Geophys. Mem. No.* 79. [18 *pp.*], 1939.—In this memoir the author continuing work of a previous memoir [see Abstract 3484 (1937)] seeks to establish (1) the relation between the depth of a depression and the intensity of its outer vortex, and (2) the extent of the relation of that depth to the intensity of the circulation in the upper part of the troposphere; further he considers whether the connection between surface and upper air suffices for the transfer of the energy found in surface regions of a depression and also explores the average air movement in the upper part of the troposphere over depressions. For this end, after examining in detail the depression of Oct. 26–28, 1936, he deals with the general features of several other depressions, twenty in all being considered. The air movements above depressions at different seasons of the year are illustrated by a number of diagrams. Among the conclusions summarised at the end it is shown that there exists an intimate relation between the pressure at the centre of a depression and the intensity of the outer vortex, the correlation coefficient being $-0{\cdot}93$. A. E. M. G.

2808. Evaporation from Land and Water Surfaces. C. W. Thornthwaite and B. Holzman. *Monthly Weather Rev.* 67. *pp.* 4–11, *Jan.*, 1939.—Results of early investigations and the effect of turbulence on evaporation are first considered. Thereafter a formula which is an outgrowth of turbulence researches is given. By this the evaporation is obtained in terms of the moisture content and wind velocity at different levels in the air. An installation for obtaining the necessary data is described along with photographic reproductions of the instruments. A number of diagrams illustrate the moisture concentration and hourly evaporation on different dates obtained at an observation post over grass with the apparatus. These are discussed and a diagram shows the daily totals of evaporation and condensation for the month of Jan., 1939. The effect of snow lying on the ground is dealt with. With further development of apparatus it is hoped to be able to obtain the actual moisture losses from all types of surfaces. A. E. M. G.

2809. Increasing Daily Minimum Temperature in Large Developing Cities. H. Arakawa. *Gerlands Beitr. z. Geophys.* **54. 3.** *pp.* **177–178, 1939.** *In English.*—Annual values of mean daily maximum (or minimum) temperature at 20 stations are analysed. The results are given in a table. They show that the mean daily maximum is nearly invariable but that the mean daily minimum is tending to increase. It is suggested that the causes are artificial generation of heat and atmospheric pollution. [See Abstract **2496** (**1937**).] A. E. M. G.

2810. Oxygen Phosphoresence in Light from Night Sky. L. Herman and R. Herman. *Comptes Rendus,* **208.** *pp.* **1392–1394,** *May* **1, 1939.**—In a discharge through a mixture of N_2 and O_2 at a pressure of a few mm., an afterglow is observed, which lasts for a few seconds. The spectrum of this has been obtained and is found to be continuous. It lies in the same spectral region as the light of the night sky, and it is suggested that the origin of both is the same. Some possible explanations of the spectrum are discussed. R. P.

2811. Photography of Earth's Shadow. C. Combier. *Comptes Rendus,* **208.** *pp.* **1520–1521,** *May* **8, 1939.**—Having referred to early observations on the shadow cast by the earth on its own atmosphere at twilight the author sets out conclusions arrived at from observations made at Ksara during the last few years. These briefly are that (1) the second twilight of evening or the " albe " is an objective phenomenon ; (2) the colouring of the sky is variable ; and (3) for the same depression of the sun below the horizon in the west the angular height of the anticrepuscular arc in the east is not constant. It is further suggested that investigations of this kind afford a new means of sounding the atmosphere. A. E. M. G.

See also **Abstracts 2771, 2902.**

SEISMOLOGY.

2812. P_cP and S_cS. E. Tillotson. *Seismological Soc. of America, Bull.* **29.** *pp.* **345–408,** *April,* **1939.**—The travel time and relative amplitudes of primary and secondary waves reflected once at the outer surface of the earth's core have been obtained from the Baluchistan earthquakes of Aug. 24 and 27, 1931, and the Alaskan earthquake of March 25, 1932. These mutually confirmed one another as far as five pulses of each and a travel-time table has been drawn up for each. All are confirmed by Gutenberg and Richter by earlier results, except P_cP about 65°, as far as readings are given and by later seismograms from Pasadena, Riverside, La Jolla, Haiwee, Tinemaha, and Santa Barbara, and also confirmed by Jeffreys except for P_cP between 30° and 65° and S_cS about 50°, where slight adjustments are necessary. Jeffreys and Gutenberg list only one P_cP pulse each, and Jeffreys and Bullen list only one S_cS pulse. The results also agree with unpublished work on the Alaskan shock, which was probably of normal focal depth, but which had a complicated beginning and an aftershock following closely on the initial shock. R. S. R.

2813. Times of P, S, and SKS, and the Velocities of P and S. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **498–533,** *June,* **1939.**—A former study of Japanese deep-focus earthquakes provided a set of corrections to the tables of Sd, Sr and SKS whose uncertainties were checked or estimated by the comparison of different earthquakes, and some data concerning the loop of the P curve. The distribution of weight with regard to distance was, however, very uneven for Sr, and the data for SKS extend only to 100° with any appreciable weight, on account of the positions of the bulk of the stations. It was therefore necessary to include the information provided by the normal and southern earthquakes already used. The method of treatment in the construction of the new tables is fully explained. The main tables give the first arrivals of P and S. Where the first arrival for one tabulated depth is Pd and that for the next deeper one is Pr, interpolation between them will sometimes give errors of a second. This can be avoided by using the following supplementary table, which gives Pd where later than Pr, Pr where later than Pd, and the upper branch. Possible sources of error are discussed. R. S. R.

2814. Times of PcP and ScS. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **537–547,** *June,* **1939.**—The observed times of PcP and ScS given by Gutenberg and Richter [see Abstract **2461** (**1939**)] lead to an estimate of $0{\cdot}5480R \pm 0{\cdot}0004R$ for the radius of the core, or $3473 \pm 2{\cdot}5$ km. The estimate is consistent with the observations made by Scrase and Stechschulte, and has a slightly smaller uncertainty. It has been used to calculate times of PcP, ScS, PcS and the various allowances for focal depth. [See following Abstract.] AUTHOR.

2815. Times of Core Waves. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **548–561,** *June,* **1939.**—The times of PcP and ScS are compared with PKP and SKS to gives times in the core, which agree satisfactorily over a range of 29°. It is found, by an extension of Airy's theory of diffraction near a caustic, that appreciable amplitudes for a diffracted PKP could not exist more than about 3° from the cusp at 142° for periods of 1^s, or 14° for periods of 10^s. The opinion of Lehmann, Gutenberg and Richter that PKP between 110° and 142° is refracted at an inner core is therefore substantiated. Some progress is made with the formation of the PKP table on this hypothesis. [See preceding Abstract.]

AUTHOR.

2816. L Phase of Seismograms. R. Stoneley. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **562–569,** *June,* **1939.**—An analysis of the times of transit of the L phase given in the *International Seismological Summary* for 15 well-observed earthquakes gives a frequency distribution which is strongly double-humped. The maxima correspond to travel rates m of about $0{\cdot}420$ and $0{\cdot}467$ min. per degree, and these refer to the onsets of the Love-wave and Rayleigh-wave phases, which are here denoted by LQ and LR respectively. Significant differences in the relative frequency of LQ and LR in different shocks are shown to occur for earthquakes in the same epicentral region, and these seem to indicate differences in the type of dislocation at the focus. The apparent values of m are grouped at 10° intervals of epicentral distance Δ, and solutions by least squares made for m as a linear function of Δ. The LQ solution is $m = 0{\cdot}4180 \pm 0{\cdot}0015 + (\Delta - 55^\circ)(0{\cdot}0403 \pm 0{\cdot}0305)$, where $\pm$ indicates standard deviations. The solution for LR is $m = 0{\cdot}4686 \pm 0{\cdot}0020 +$

$(\Delta - 55°)(0{\cdot}030 \pm 0{\cdot}041)$. In both cases the $(\Delta - 55°)$ term is not significant, so that m may be regarded as constant. The weighted mean values are then $LQ = 0{\cdot}4195 \pm 0{\cdot}0012$, corresponding to $4{\cdot}426 \pm 0{\cdot}013$ km./sec.; $LQ = 0{\cdot}4674 \pm 0{\cdot}0011$, equivalent to $3{\cdot}972 \pm 0{\cdot}009$ km./sec. The ratio of these velocities is 0·90, in fairly good accordance with the predicted ratio of 0·92. AUTHOR.

*2817. **Low-Magnification Attachment for Milne-Shaw Seismograph. J. H. Peters.** *Seismological Soc. of America, Bull.* 29. *pp.* 341–343, *April*, 1939.—As the Milne-Shaw horizontal component seismograph at this station (Honolulu) is easily thrown out of action by a shock of moderate intensity the attachment was devised to come into operation on the occurrence of such a shock. Its essential points are that the recording mirrors are fixed directly to the boom of the seismograph, and auxiliary recorders provided, while the drum is driven by a storage battery, so as not to be affected by a possible breakdown in the public supply. The arrangement is figured. C. A. S.

See also Abstract 2765.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2818. Origin of Tracks of Lightning Flash and Resulting Processes. B. Walter. *Ann. d. Physik*, 34. 7. *pp.* 644–664, *April*, 1939.—Several facts observed and recorded regarding the tracks of a flash of lightning as well as some of the resulting processes noticed in the same which have been recently dealt with by Schonland and his co-workers [see Abstract 2383 (1938)] have in the view of the author of this paper not been rightly explained and he refers to his previously published paper [see Abstract 1425 (1903)]. J. J. S.

2819. Mechanism of Lightning Discharge. J. M. Meek. *Phys. Rev.* 55. *pp.* 972–977, *May* 15, 1939.—The leader stroke mechanism for the lightning discharge is explained on the basis of ion recombination in the discharge channel. It is assumed that a pilot streamer advances continuously from cloud to ground at a speed of 2×10^7 cm./sec. The current which flows into the tip of the pilot streamer is calculated as 0·1 A, and it is considered that this current must be maintained at an approximately constant value for the pilot streamer to propagate. The resistance of the channel which joins the pilot streamer to the cloud is then calculated in terms of the ion density, and it is shown that the voltage gradient increases sufficiently to cause successive breakdown of the channel to occur at intervals of some 50 μsec., *i.e.*, the stepped leader stroke. The high speed of step and dart leaders is explained by the fact that the ion density ahead of their tips is about 10^{10} and 10^7 per cm^3. respectively. AUTHOR.

*2820. **Large Ion Counter Giving Directly the Mobility Spectrum. P. Queney.** *Comptes Rendus*, 208. *pp.* 1521–1523, *May* 8, 1939.—By this apparatus built at the Observatory of the Puy de Dôme it is possible to obtain directly the mobility spectrum of the ions. It consists essentially of two cylindrical condensers placed end to end. Details of the condenser and the method of carrying out observations are given. The first condenser acts as a filter, the second as an analyser. The internal electrode of the latter is divided into two parts, the second only being connected to an electrometer. An expression for the current to the electrometer is established in terms of the mobility and the spectral distribution of the number of the ions. Causes of error still existing are referred to and an arrangement is suggested whereby all faults could be eliminated. A. E. M. G.

2821. Time Interval between Solar Eruptions and Magnetic Storms. J. Coulomb and G. Dugast. *Comptes Rendus*, 208. *pp.* 1557–1559, *May* 15, 1939.—The results of previous measurements by Hale and Maurain show intervals of 24–30 and 40 hr. respectively. In this case the magnetic observations at Tamanrasset over the period 1/5/34 to 31/8/38 were used. For 23 cases of sudden magnetic storms, when during the preceding four days, calm or nearly calm conditions prevailed, an interval of 24–30 hr. was found. Eliminating sunrise and sunset observations the agreement with Hale was even closer. For 29 storms having a less sudden commencement the same time interval could be perceived. [See Abstract 3186 (1938).] R. S. R.

2822. Earth Currents on Volcano Aso. Parts I and II. M. Namba. *Kyoto Coll. Sci., Mem.* 21. *pp.* 203–217, *Nov.*, 1938, *and* 22. *pp.* 35–39, *March*, 1939. *In English.*—It is a well known fact that there is always a certain definite ascending current along an inclined earth surface. The writer has measured the distributions of the potential gradient of the earth current near the mountain tops of several volcanic cones, and arrived at the conclusion that the ascending current of a cinder cone is mainly due to the streaming potential caused by the soil pressure difference. In Jan., 1936 he measured the distributions of the potential gradients of the earth-current in the old atrio of Aso and came to the following conclusions :— (1) There are some anomalous distributions of the earth-current in the neighbourhood of the volcanic tectonic lines. (2) Under the NW part of the atrio, a magma reservoir seems to exist. (3) The barranco of Taténo may be an erosional valley and not a graben. (4) Nothing can be said about the problem of the Aso volcanic sink because no measurements of the somma are available. AUTHOR.

See also Abstract 3057.

RADIOACTIVITY.

2823. Possibility of Multiplicative Disintegration of U. F. Perrin. *Comptes Rendus*, 208. *pp.* 1394–1396, *May* 1, 1939.—In the disintegration of U by neutrons, neutrons are also produced as reaction products, the number of the emitted neutrons exceeding that of the absorbed ones. Taking into account only the effect of the fast neutrons, it follows then that a sufficiently big mass of U would be explosive. From present experimental figures, the critical radius for a sphere is estimated to be 130 cm. By surrounding the sphere with a layer which scatters neutrons, but does not absorb them, the critical radius may be reduced to 86 cm. Slow neutrons may show strong effects already for smaller sizes. Then, however, there is no question of an explosion, since the efficiency of slow neutrons depends on the temperature and therefore an equilibrium will be reached. R. P.

2824. Simple Capture of Thermal Neutrons and of Resonance Neutrons by U. H. v. Halban, Jr., L. Kowarski and P. Savitch. *Comptes Rendus*, 208. *pp.* 1396–1398, *May* 1, 1939.—Simple capture of neutrons in U, as distinct from the capture with subsequent fission of the nucleus, produces an isotope of U with subsequent β-decay. The cross-section for this process is measured by comparing it with the cross-section of gold nuclei, and found to be $(1 \cdot 3 \pm 0 \cdot 45) \times 10^{-24}\ \mathrm{cm}^2$. There is also a resonance band for this process, and this is found to be remarkably wide. The chance that a fast neutron, in the course of being slowed down should happen to have at one time an energy within this band, is found to be $0 \cdot 16 \pm 0 \cdot 025$; this is approximately equal to the ratio of band width to the energy of the band. R. P.

2825. Retardation in Air of Atomic Fragments Produced by Rupture of U. G. Beck and P. Havas. *Comptes Rendus*, 208. *pp.* 1643–1645, *May* 22, 1939.—The discrepancy in the path of the ions resulting from rupture of U according as determination is by an ionisation or other method is explained as due to their rapid neutralisation by electrons obtained from molecules of air, and consequent non-recognition by an ionisation method after such neutralisation. [See Abstracts 2013 and 2016 (1939).] C. A. S.

2826. Fission of Heavy Nuclei. New Type of Nuclear Disintegration. N. Feather. *Nature*, 143, *pp.* 877–879, *May* 27, 1939.—History of nuclear fission from Fermi's demonstration in 1934 of β-activity produced on bombardment of U by neutrons. Although the fission process has been recognised for only a few months, over 20 papers are quoted after rigorous selection. The products of the fission, which occurs also with Th, are elements between La and I, most of which are radioactive. The energy involved in the fission is 100–200 eMV. Copious instantaneous and delayed emission of neutrons also occurs. Since the energy of the neutrons released is sufficient to disintegrate other U nuclei, the possibility of a chain reaction must be considered. F. C. C.

2827. Excitation Functions of (α, n)-Transmutations of Be and B. E. Fünfer. *Ann. d. Physik*, 35. 2. *pp.* 147–152, *May*, 1939.—Excitation curves of neutrons emitted by Be and B under bombardment by ThC′ α-particles are obtained from measurements with proportional counting tubes [see Abstract 3633 (1938)]. Numerous resonance levels are found. Their width is less than 70 kV, and the distance between consecutive levels is of the order of 200 kV; as in previous work many resonance levels are found which lie above the threshold potential. Results are tabulated and possible reactions discussed. E. E. W.

2828. Transformation of B by Slow Neutrons. W. Maurer and J. B. Fisk. *Zeits. f. Physik*, 112. 7–8. *pp.* 436–452, 1939.—Transformation of B^{10} by means of slow neutrons is reported for 40,000 instances in BCl_3 vapour in an ionisation chamber. Not only α-particles as already reported, but also protons, are formed on nuclear disintegration, and the process can be arranged into ${}_5\mathrm{B}^{10}(n, \alpha)_3\mathrm{Li}^7$ and ${}_5\mathrm{B}^{10}(n, p)_4\mathrm{Be}^{10}$. In the (n, α) transformation 4–5 energy groups appear, the highest at $2 \cdot 90 \times 10^3$ eV agrees well with the value $2 \cdot 98 \times 10^3$ eV deduced from nuclear mass. For Li^7 3–4 excitation stages are deduced, at $E = 200, 410, 640, (840\,?) \times 10^3$ eV in agreement with results in other excitation reactions. Numerous references are included. D. R. H.

2829. K-Electron Capture, Nuclear Isomerism and Long-Period Activities of Ti and Sc. H. Walke, E. J. Williams and G. R. Evans. *Roy. Soc., Proc.* 171*A*. *pp.* 360–382, *June* 6, 1939.—A study has been made of the long-period activities induced in Ti and Sc by activation with deuterons of high energy and in Ti by activation with 11 eMV α-particles. A radioactive isotope of V has been established of half-life 600 ± 50 days which decays almost entirely by K-electron capture. It is ascribed to V^{47}. The ratio of K-capture to positron emission has been studied in V^{48}. The observed X-ray intensity is incompatible with that required by the Fermi interaction, the ratio K-capture/positron emission being 0·40 ± 0·15. An isomeric form of Ti^{51} has been detected of half-life 72 ± 2 days which decays by emitting electrons of maximum energy 0·36 eMV, the product nucleus V^{51} being always left in an excited state of energy 1·0 eMV. The branching decay of Sc^{46} by K-electron capture and emission has been observed. The half-life of Sc^{46} has been confirmed as 85 ± 1 days, the maximum energy of the disintegration electrons being 0·26 eMV. γ-radiation of energy 0·95 eMV is also emitted.

Authors.

2830. Total and Specific Ionisation of Po α-Particles and their Statistical Fluctuations. J. M. W. Milatz and G. A. W. Rutgers. *Physica*, 6. *pp.* 529–550, *June*, 1939. *In English.*—From the two series of measurements of the total and specific ionisation, it is possible to deduce the mean ionisation curve of an α-particle with given range, on certain assumptions mentioned. The result of the measurements is, that on the last portion of the path, the shape of the ionisation curves is the same for the particles with different range. Further, it has been shown that the specific ionisation is proportional to the loss of energy of the particle. The straggling in total and specific ionisation is determined for a number of distances between source and chamber. Finally the Bragg curve and the mean specific ionisation curve of the particles with mean range are compared.

Authors.

2831. γ-Ray Ion Currents in Air at High Pressures and High Gradients at High and Low Temperatures. J. W. Broxon and G. T. Merideth. *Phys. Rev.* 55. *pp.* 883–893, *May* 15, 1939.—Weak γ-ray ionisation currents in air at pressures extending to 193 atm. were measured at − 76° C. and at 96° C. The same apparatus and procedure were used as in the room-temperature measurements with collecting field intensities from 0·17 to 4500 V/cm. Under all conditions the current increased with increase of field intensity. At − 76° C. the current corresponding to a particular intense collecting field has a pronounced maximum in the neighbourhood of 60 atm. No such maxima were observed at 96° C. As at room-temperature, negative ion currents were found to be greater than the corresponding positives. In their dependence upon temperature and gas density the observed temperature coefficients of the currents agree well with the predictions both of the initial recombination theory and of the columnar theory in the region of low collecting field intensities. They further display the dependence upon field intensity required by the columnar theory. Adopting the assumptions of Gross relative to dependence of the ordinary ion coefficients upon temperature, the authors have modified the coefficient in Zanstra's equation (based upon the Jaffé columnar theory) to correspond to the new temperatures. The result was fairly satisfactory. The theoretical saturation currents so obtained display unexpected relations to gas density. At − 76° C. the theoretical saturation current has a pronounced maximum at about 90 atm. At 96° C. the theoretical saturation current values increase very rapidly with increase of pressure at the high pressures. [See Abstract 3202 (1938).]

Authors.

***2832. "Slow" Wilson-Chamber Experiments. H. Maier-Leibnitz.** *Zeits. f. Physik*, 112. 9–10. *pp.* 569–586, 1939.—An expansion chamber is described having an expansion interval of 1–2 sec., giving a "time cross-section" some 50 times that of the usual type of Wilson-chamber, and a correspondingly greater "sensitivity." The chamber was used to study the following three problems: (*a*) A search was made for electrons released by the interaction of neutrons with matter. No such electrons were found in the 14,000 tracks obtained. (*b*) The γ-ray spectrum of Be^7 was investigated by means of the secondary electrons ejected from a thin Pb foil. The energy distribution obtained from 900 expansions shows that it consists of a line at 425 kV, agreeing with the hypothesis that the disintegration of the Be^7 nucleus proceeds by the capture of an electron, leading to an excited Li^7 nucleus which is responsible for the γ-ray emission. [See also Abstract 4889 (1938).] (*c*) Tracks produced by radiation penetrating a sheet of Pb 5 cm. thick were studied. The showers of hard radiation are attributed to mesotrons, and it is suggested that the slow mesotrons which are also found are produced from the hard component. The properties of the mesotron are discussed in the light of the present results and those of other workers. E. E. W.

***2833. Wilson Cloud-Chamber with Several Expansions per Second. H. Brinkman.** *Physica,* 6. *pp.* 519–528, *June,* 1939. *In English.*—In this paper a description is given of a continuously running cloud-machine, permitting many expansions in a second, suitable for various experiments in nuclear physics, especially for rare nuclear phenomena or for those with a short lifetime, and cosmic-ray investigations. AUTHOR.

***2834. Mechanism of Vapour-Filled Geiger-Müller Counters. R. Tuokko.** *Soc. Scien. Fennica,* 3. 2. [55 *pp.*] 1939. *In German.*—Size and shape of the pulses in a Geiger-Müller counter are measured as a function of the constants of the electrical circuit employed and of the total pressure and composition of the gas. In the interpretation of the results the author stresses the importance of the gas layer at the kathode of the tube L. E. F.

See also Abstracts 2796, 2797, 2844, 2873.

RADIATION.

COLORIMETRY.

2835. Colour Characteristics of Artists' Pigments. N. F. Barnes. *J.O.S.A.* 29. *pp.* 208–214, *May,* 1939.—Fifty-one water pigments were examined in the form of matt coatings of sufficient thickness to hide the supporting paper. The mixture used for each coating had a high pigment content. The composition of each pigment is given in the paper. Spectral reflection curves were determined with a recording photoelectric spectrophotometer and are all reproduced. From these curves the tristimulus values and trichromatic coefficients have been computed on the I.C.I. system, using standard illuminant C. These values are tabulated as well as the dominant wave-length, relative brightness and excitation purity. A subsidiary examination of three samples each of three selected pigments shows the degree to which the results are representative of the average performance of a given material. J. W. T. W.

See also Abstract 2922.

ELECTRO-OPTICAL AMD MAGNETO-OPTICAL EFFECTS.

2836. New Magneto-Optical Phenomenon. Q. Majorana. *Accad. Lincei, Atti,* 29. *pp.* 11–14, *Jan.,* 1939.—A new method is described to observe the double refraction of light induced by the application of a magnetic field in colloidal solutions. The change in the intensity of light passing through a solution of colloidal Fe which is placed between the poles of an electromagnet, are measured with a Cs photocell. If the magnetic field is switched on, an increase or decrease of the transmitted intensity is observed. Whether it will be an increase or decrease, depends on the preparation and ageing of the solution and cannot be controlled beforehand. If the transmission of light is increased for the case that the magnetic field is parallel to the direction of the light, it will be decreased for perpendicular force lines, and vice versa. It has been found that the increase in intensity is always greater than the corresponding decrease. L. K.

***2837. Improved Methods of Illumination for Measurements of Accidental Double Refraction. Y. Björnståhl.** *J.O.S.A.* 29. *pp.* 201–207, *May,* 1939.—It is shown that nearly all illumination devices hitherto used in the measurement of magnetic, electric and mechanical double refraction are inefficient. A description is given of methods for producing a rational illumination by means of which it is possible to carry out measurements on substances that otherwise could not be investigated. AUTHOR.

2838. Influence of Electric Field on Emission Bands in Electro-photo-luminescence. G. Destriau and G. Loudette. *Comptes Rendus,* 208. *pp.* 1569–1571, *May* 15, 1939.—The intensity I of the light emitted from photoluminescent substances under the influence of strong alternating electric fields is related to the applied voltage V by the expression $I = Ae^{-B/V}$, A and B being constants. For some substances, B is independent of wave-length, and the intensity distribution in the emission bands is then independent of voltage. For others, B varies with wave-length, and increase in voltage then causes a regular displacement of the maximum intensity of emission. The variation of B with wave-length is measured for three phosphors of the latter class. C. B. A.

See also Abstract 2968.

EMISSION.

2839. Photon Theory. B. Kwal. *Comptes Rendus,* 208. *pp.* 1387–1389, *May* 1, 1939.—In de Broglie's theory of the photon only 16 of the 31 equations are independent. By the use of matrices the theory is formulated employing only these 16 equations. G. O. B.

2840. Radiation of High Pressure Mercury Discharge. J. Kern and P. Schulz. *Zeits. f. techn. Physik,* 20. 5. *pp.* 148–152, 1939. *In German.*—Explanations are given of earlier measurements of the effect of power consumption, pressure of Hg vapour and tube diameter on the amount and spectral distribution of the radiation in the visible and u.v. emitted by high pressure Hg tubes. W. S. S.

2841. Lemaître-Vallarta Theory of Cosmic Radiation. A. Baños, Jr. *Frank. Inst., J.* 227. *pp.* 623–645, *May,* 1939.—This paper contains a brief exposition of the fundamental principles underlying the Lemaître-Vallarta theory of the accessibility of the earth to the charged particles of the primary cosmic radiation, including, for the sake of completeness, the derivation of the equations of motion of a charged particle in the field of a magnetic dipole; a brief discussion of the application which

Lemaître and Vallarta made of Liouville's theorem; and finally, a detailed account of Störmer's fundamental contributions dealing with the normalisation of the equations of motion and the conformal transformation of the meridian plane. D. H. F.

2842. Fast and Slow Mesotrons in Cosmic Radiation. W. Bothe. *Naturwiss.* 27. *pp.* 305–312, *May* 12, 1939.—This paper discusses in the light of recent experimental and theoretical work the hard, narrow-angle showers studied by Bothe and Schmeiser [see Abstract 2423 (1938)]. It is concluded that this supports the hypothesis that these showers consist primarily of mesotrons, and that the production of secondary mesotrons by the energetic mesotrons constituting the hard component of the cosmic radiation is a frequently occurring process. D. H. F.

2843. Secondary Neutrons in Cosmic Radiation. M. Ageno. *Ricerca Scientifica,* 10. *pp.* 273–274, *April,* 1939.—A repetition with completely negative results of the experiments of Froman and Stearns [*Phys. Rev.* 54. *p.* 969, *Dec.* 1, 1938], which appeared to establish the emission of neutrons of very high energy from lead. L. E. F.

2844. Range of Nuclear Forces and Disintegrations by Cosmic Rays. E. Bagge. *Ann. d. Physik,* 35. 2. *pp.* 118–134, *May,* 1939.—If interaction potentials proportional to Ae^{-r^2/a^2} are assumed between the particles in the nucleus (A and a are constants) Heisenberg has shown that the energy spectrum of the secondary heavy particles emitted in a collision of a fast neutron or proton with the nucleus depends on the constant a, determining the range of the forces, alone. Comparing theory with the experimental results of Blau and Wambacher, who observed nuclear disintegrations produced in photographic emulsions by cosmic rays, the author finds that while the maximum transfer of energy to the nucleus in such a collision is larger than predicted by the theory, the theoretical and experimental energy spectra are in fairly good agreement down to energies of 10 eMV if the value of $(0 \cdot 8 \pm 0 \cdot 1)\, r_0$ is accepted for a (r_0 is the electronic radius). This, in combination with the value of Aa^2 as deduced from the observed mass defects of nuclei, leads to the value of 35·7 eMV for A. The discrepancy at lower energies is due to evaporation from the rest of the nucleus of particles of lower energy following upon the ejection of the high energy particles. In both processes an approximately equal number of neutrons and protons is emitted, so that, due to their longer range, the intensity of neutrons in the cosmic radiation should be about 250 times that of protons, in agreement with observations of Schopper on paraffin covered photographic plates. L. E. F.

2845. Time Variations of Cosmic Rays. A. H. Compton. *Frank. Inst., J.* 227. *pp.* 607–620; *Disc.,* 621, *May,* 1939.—An account is given of the present state of theoretical and experimental research on time variations in the intensity of cosmic rays. The effects periodic with the solar and sidereal day, with the period of either the rotation of the sun or the revolution of the moon and with the seasons are treated, further the non-periodic variations following changes in the earth's magnetic field and the temperature of the atmosphere. Attention is drawn to two paradoxa, one concerning the temperature-coefficient, which appears to be positive for daily and negative for seasonal changes of temperature, the other concerning an observation of the effect of the earth's magnetic field at a latitude (66°) where, according to theory there should be no such effect. The question of the source of the rays was thought to be experimentally decided in favour of an intra-galactic origin by observations of the variation with sidereal time, but recent work of Vallarta, Graef and Kusaka has shown that by properly adjusting the proportion of negative to positive particles supposed to be in the incoming rays, almost any experimental data on that effect could be reconciled with an extra-galactic origin of the rays. It seems most plausible, however, to assume a strong preponderance at least of positive particles. According to Alfven the resulting space charge could be neutralised by a distribution all through the galaxy of interstellar negative ions. As these would rotate with the galaxy a strong magnetic field ($\sim 0\cdot 1$ Gauss) affecting only particles of extra-galactic origin would arise and act as a barrier against the entrance of such particles into the galaxy. On the other hand a star with a magnetic field at its surface will control the motion of electrons up to a far greater distance than that of positive ions, and the magnetic field due to the resulting electron currents will enormously increase the cross-section of the star for collision with a cosmic ray (with a surface field of 30 Gauss the sun would by this mechanism still deflect 10^{10} eV-particles at a distance of $\sim 0\cdot 1$ light years). The magnetic field of the galaxy would in this way prevent the escape of any intra-galactic particles. So the hypothesis is suggested that the cosmic rays are an accumulation of all the energetic particles ever produced *within* the galaxy. The absence of γ-rays from the primary radiation follows at once from this hypothesis and the difficulty is avoided of accounting for the huge energy of a cosmic radiation distributed homogeneously over all space. In the *Discussion* **W. F. G. Swann** pointed out that galaxies with magnetic fields of $\sim 0\cdot 1$ Gauss at the centre would attract each other if properly orientated. Our galaxy would acquire 1/10 of the velocity of light within 10^5 years by interaction with a similar one at a distance of 200,000 light years. A galaxy of this velocity would have a high electric moment for a point at rest, and could produce a potential of 10^{22} V at a distance from its centre comparable with its radius. L. E. F.

2846. Variation of Cosmic-Ray Intensity. J. Barnóthy and M. Forró. *Phys. Rev.* 55. *pp.* 868–870, *May* 1, 1939.—Shower and vertical intensities obtained over a period of a year were analysed. A correlation between shower intensities and meteorological and magnetic factors was found ; the relation of the variations to the corresponding vertical intensity variations were found to be in accordance with the hypothesis that the showers at sea-level are produced by the electrons arising from the disintegration of mesotrons in the lower portion of the atmosphere. Harmonic analysis showed the existence of a diurnal and a sidereal periodicity in shower intensity : the diurnal variation appears to be merely a consequence of the daily variation in the air temperature, but the variation with sidereal time seems to be a consequence of the galactic rotation.

D. H. F.

2847. Intensity Variations of Cosmic Rays and Activity of the Sun. G. R. Miczaika. *Zeits. f. Astrophysik*, 18. 2. *pp.* 146–150, 1939.—In continuation of an investigation by Kolhörster [see Abstract 1616 (1939)] intensity variations of cosmic rays are correlated with variations in solar surface activity for two periods, Sept., 1937 to Dec., 1937 and June, 1938 to Sept., 1938 which together with the period covered by Kolhörster complete the observations for a full year. Correlation coefficients for sunspots, bright H_α faculæ and Ca faculæ are all negative and are least in the case of sunspots. It is concluded that the solar occurrences considered are definitely responsible for some but by no means all of the variation in cosmic-ray intensity. J. E. K.

2848. Cosmic-Ray Particles at Great Depth. J. Barnóthy and M. Forró. *Phys. Rev.* 55. *pp.* 870–872, *May* 1, 1939.—In measurements made in a coal-mine at 980 m. water-equivalent depth, it was found from double and triple coincidence observations with no absorber between the tubes that the efficiency of a Geiger-Müller counter was only about 5% : it is inferred that the major part of the radiation thus measured is feebly ionising. Measurements of double coincidences with an absorbing layer of Pb up to 1·4 cm. thickness between the tubes were consistent with the conclusion that at great depths the majority of the ionising radiation consists of shower particles which are softer than the particles of the showers at sea-level. Triple coincidences were measured for counters in the same vertical plane with Pb up to 120 cm. thickness arranged in various dispositions. The authors suggest that the results obtained are consistent with the supposition that at this depth the radiation consists of a non-ionising component (neutrinos or neutrettos) and an ionising component (mesotrons or protons) ; the former preponderates and is accompanied by secondaries which give rise to cascade showers. It is considered that the heavy ionising particles are not likely to be secondaries originating in the earth. D. H. F.

2849. Decrease of Intensity of Cosmic Rays in the Earth. J. Clay and A. v. Gemert. *Physica,* 6. *pp.* 497–510, *June,* 1939. *In English.*—The intensity of cosmic radiation was measured at 9 different levels in a coal mine, varying from 10 m. to 1380 m. water equivalent by means of three different threefold counter systems. The first instrument was the same as that with which the intensity was measured in water down to 450 m. For this reason it was possible to find the relation between the decrease in rock and in water, from which relation it resulted that the decrease depends on the electron density of the material and not on its density itself. At each depth the intensity was also measured with two other systems, these being such that 5 cm. Pb could be brought between each of the sets and the values are given in the absence of Pb and partly with 5 cm. Pb and 10 cm. Pb. The same counters were placed at a distance apart of 125 cm. and the number of coincidences measured with 10 cm. Pb and 100 cm. Pb between the counters at 10, 85, 219, 311 and 427 m. water equivalent. At the lowest depth it was found that the primary rays still ionise. At each depth, except 1170, the number of showers was determined. Below 200 m. water equivalent the number of secondaries and showers increases down to 427 m. and then diminishes. It is concluded that for energies of about 5 × 10^{10} eV the radiation of mesotrons increases considerably. The fact that below 427 m. this increase of secondaries stops, seems to indicate that the rays which penetrate below this depth are of a different nature. The increase below 427 m. water down to 1380 is given by $I = I_0 h^{-2.92}$. These rays must be considered to be protons. AUTHORS.

2850. Penetrating Cosmic Rays in Water and Rock. P. H. Clay, A. v. Gemert and J. Clay. *Physica,* 6. *p.* 510, *June,* 1939.—A correction to the original. [See Abstract 1141 (1939).]

2851. Large Cosmic-Ray Showers. P. Auger, R. Maze and Robley. *Comptes Rendus,* 208. *pp.* 1641–1643, *May* 22, 1939.—The variation with separation of the counters of the showers originating in the atmosphere [see Abstract 1138 (1939)] was measured for separations up to 300 m. at altitudes of 3450 m. and 2870 m. For separation > 20 m. the frequency is much greater than that to be expected for cascade showers. With a counter arrangement consisting of two heavily shielded counters one above the other separated by a variable thickness of Pb, and a third counter at a distance of 3 m., the variation of frequency with thickness of Pb was measured: at 20 cm. Pb the frequency was still as much as one-tenth that for zero Pb. It is concluded from both these experiments that it is very likely that the showers contain mesotrons. D. H. F.

2852. Rossi Transition Curve for Small Angle Showers. W. M. Nielsen, J. E. Morgan and K. Z. Morgan. *Phys. Rev.* 55. *pp.* 995–997, *June* 1, 1939.—Measurements have been made of 7° and 28° cosmic-ray shower production in iron up to thicknesses of approximately 320 gm./cm^2. A comparison of the data here presented and measurements previously reported for 38° showers leads to the conclusion that there is no significant difference in the ratio of counting rates at the first maximum of the Rossi transition curve to that under 200 gm./cm^2. for either large or small angle showers. It is concluded that the processes which are responsible for the character of the transition curve under large thicknesses of material are not necessarily restricted to small angles. AUTHORS.

2853. Primary Radiation of Hard Cosmic-Ray Showers. K. Schmeiser. *Zeits. f. Physik,* 112. 9–10. *pp.* 501–511, 1939.—The proportion of showers produced in Pb by ionising and non-ionising particles is measured for two thicknesses of Pb and two angles of divergence of the showers. Special care was taken to correct for showers originating outside the Pb. With 1·5 cm. of Pb 66% of the more divergent showers (21°), but only 35% of the less diverging showers (3°) were due to ionising particles, with 15 cm. of Pb this proportion was 75% for the less divergent showers (which alone were measured). This variation with the angle of divergence explains the disagreement between some previous investigations of this effect. In the view of the author the penetrating (less divergent) showers at 15 cm. of Pb (the second maximum of the Rossi curve) are mesotron showers and due to mesotrons, 25% of which might be neutral, while the penetrating showers at 1·5 cm. of Pb are mesotron showers produced by photons. The less penetrating showers are of the cascade type and produced partly by electrons or mesotrons, partly by photons. L. E. F.

2854. Comparison of Cosmic-Ray Showers Underground and at Sea-Level. D. H. Follett. *Phys. Soc., Proc.* 51. *pp.* 585–591, *July,* 1939.—With assemblies of five and four counters used alternately, measurements of cosmic-ray shower-frequencies from various thicknesses of lead were carried out (*a*) at sea-level, under a thin roof and under a screen of bricks 1m. thick, and (*b*) underground at a depth of 30 m. in a clay soil. Comparison of the results obtained with the two assemblies enables conclusions to be drawn regarding the size of the showers. The results at sea-level under a thin roof are in accordance with the predictions of the cascade theory of shower-production: underground the interpretation of the results is less unequivocal, but it is shown that when allowance is made for the spatial association of the rays incident on the counting assembly (due to the proximity of the roof of the tunnel in which the experiments were carried out) there is no reason to suppose that cascade processes of shower-production do not predominate there, as they do at sea-level. The results obtained at sea-level under a screen of bricks corroborate this conclusion. AUTHOR.

2855. Size-Distribution of Cosmic-Ray Bursts from 10 cm. Fe. A. Sittkus. *Zeits. f. Physik,* 112. 9–10. *pp.* 626–628, 1939.—From measurements of 14000 bursts, observed with an ionisation chamber, the size-distribution of bursts from 10 cm. Fe was found to conform closely to the relation $N = N_0 a^{-1.82}$, where N = frequency of bursts of size $> a$. On the basis of the conclusion of Euler and Heisenberg that bursts from 10 cm. Fe are principally due to explosion processes originated by mesotrons, it follows that the energy distribution of the mesotrons at the earth's surface is given by $g(E) \sim E^{-1.82}$, which is in good agreement with the results of cloud-chamber observations on single particles. D. H. F.

2856. Cosmic-Ray Bursts at High Altitude. H. J. J. Braddick. *Roy. Soc., Proc.* 171*A. pp.* 314–321, *June* 6, 1939.—Measurements of cosmic-ray bursts have been made in an aeroplane up to heights of 9·2 km. The number of large bursts is found to increase more rapidly than the number of small bursts, and both large and small bursts more rapidly than the number of showers recorded by counters. This is taken to indicate a change in the energy distribution of the electrons with height. At a height of 9 km., the ratios of large bursts, small bursts, showers, and singles to the corresponding values at sea-level are approximately 125 : 1, 90 : 1, 57 : 1, and 18 : 1. AUTHOR.

2857. High Altitude Cosmic-Ray Measurements near the North Geomagnetic Pole. H. Carmichael and E. G. Dymond. *Roy. Soc., Proc.* 171*A. pp.* 321–344, *June* 6, 1939.—Measurements of cosmic radiation have been made at very high altitudes near the north geomagnetic pole with two kinds of apparatus, namely a triple coincidence apparatus with radio transmission of the data and an ionisation apparatus which was self-recording. The lowest atmospheric pressure reached by the vertical coincidence apparatus was 52 mm. Hg, and by the ionisation apparatus 12·5 mm. Hg. Comparison of the authors' results with those obtained by others between geomagnetic latitudes 49° and 60° N. shows that no appreciable quantity of low energy cosmic radiation is reaching the earth from outer space. In particular the very good agreement between the shape of the curve showing ionisation against pressure at geomagnetic latitude 85° N. and similar curves of Millikan and his co-workers at geomagnetic latitudes 55° and 60° N. indicates a complete absence of incoming radiation in the energy range from 3×10^7 eV to about 10^9 or 2×10^9 eV. Possible causes of the absence of such low energy rays are indicated. AUTHORS.

See also Abstracts 2837, 3042.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2858. Measurements of Fluorescence and of Absorption with Benzene Derivatives, especially in Condensed Systems. H. Ley and H. Specker. *Zeits. f. wiss. Phot.* 38. *pp.* 13–27, *Jan.–March*, 1939.—The authors' measurements on fluorescence in alcoholic and in hexane solution and on absorption spectra are recorded and discussed, and numerous references to other workers are given. The following substances were studied: benzene, diphenyl methane, dibenzyl, stilbene, isostilbene, α-methylstilbene, tetraphenyl ethylene, dibenzyl ethylene, diphenylamine, diphenyl ether, diphenyl sulphide, phenol, thiophenol, fluorene, biphenylene oxide, carbazol, diphenylene sulphide, diphenyl. S. J. G.

2859. Phosphorescence of Zinc Silicate Phosphors. G. R. Fonda. *J. of Applied Physics*, 10. *pp.* 408–420, *June*, 1939.—At low contents of the Mn activator, the decay of phosphorescence takes place in two stages. The initial stage is exponential. It is complete in less than 0·1 sec. and is not affected by temperature. The second stage is at a much lower intensity level. It becomes noticeable after 0·03 sec. and persists for more than an hour. Its speed of decay increases with temperature. At − 196° C. it is completely latent. A change in the intensity of the exciting light alters proportionally the luminescence caused by each stage of decay and has no effect upon the shape of the decay curves. About fifty times as many electrons are involved in the second stage of decay as in the first. It is assumed that the second stage is caused by the retention of electrons in a metastable state, probably one associated with the presence of lattice imperfections. The exponential decay of the first stage would result from the recombination of Mn ions, relatively in excess, with those free electrons which had not been captured in the potential cups of the metastable state. The decay of phosphors rich in Mn is always very abrupt and at a speed which rises rapidly with increase in temperature. The course of decay can be represented by the expression $p^{-x} = a + bt$ except at reduced temperatures where the two stages of decay characteristic of low Mn content are observable. AUTHOR.

2860. New Effect with Luminescent Zinc Sulphide. N. Riehl. *Zeits. f. techn. Physik*, 20. 5. *pp*. 152–155, 1939. *In German.*—For some zinc-cadmium sulphide luminophores the luminescence increases with the exciting u.v. intensity at a rate greater than that corresponding to proportionality. This effect is the more marked if the temperature is raised and it then occurs for all zinc and zinc-cadmium sulphides. The author has previously found that the decay time is shorter the greater the excitation and he concludes that " the probability of the transformation of the absorbed quantum into heat is the greater, the longer the energy remains in the crystal." An explanation of the lack of proportionality between luminescence and excitation is advanced on this basis. W. S. S.

2861. Effect of Substituents on Luminescent Power of Phthalaz-1 : 4-diones. H. D. K. Drew and R. F. Garwood. *Chem. Soc., J. pp*. 836–837, *May*, 1939.—Several naphthalazdiones have been prepared, and their luminescent powers compared with those of corresponding phthalazdiones. The effects of substituents are in a similar sense in the two series; but the latter series is the more luminescent, except as regards the parent compounds. 5-Methylphthalazdione and some halogenated phthalazdiones have also been prepared and examined. The first presents an anomaly in luminescent power. AUTHORS.

2862. Simple Arrangement for Measuring the Equilibrium Potentials of Luminescent Screens under Electron Bombardment. R. Frerichs and E. Krautz. *Phys. Zeits.* 40. *pp*. 229–230, *April* 1, 1939. —The screen is formed by a layer of the luminescent material, which covers the inside of a thin glass plate which closes the end of a cylindrical tube, and is hit by a magnetically focused electron beam. The outside of the glass plate is covered by a conducting layer and connected to an electrometer of small capacity. Control experiments show that the conductivity of the screen and of the glass are sufficient to make the electrometer potential equal to that of the screen. The results agree with those of Bey [see Abstract 2051 (1939)]. R. P.

See also Abstract 2838.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2863. Structure and Optical Characters of Iridescent Glass. C. V. Raman and V. S. Rajagopalan. *Indian Acad. Sci., Proc.* 9A. *pp*. 371–381, *May*, 1939.—A study of numerous specimens and of 30 photo-

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micrographs of the same shows that the structures in decomposed glass may be divided into six categories exhibiting distinct optical phenomena: (1) cavities with terraced walls; (2) films exhibiting iridescence of varying colour without defined boundaries; (3) films exhibiting map-like patterns of colour with sharply defined laminar boundaries; (4) films containing unresolved or imperfectly resolved structures scattering light; (5) films containing hollow cavities, and (6) dark areas which neither reflect nor scatter light. Contrary to Brewster's observation, the colours of decomposed glass actually become more striking when the material is covered by liquid; the intensity diminishes but does not disappear even when the index of the surrounding fluid is identical with that of the film. The films are capable of absorbing liquid in variable amount, their colours being altered thereby. The openness of internal structure indicated by this fact is confirmed by observations on the effect of mechanical pressure on the iridescence, and on the polarisation of the reflected light at various incidences both in air and when submerged in liquids. AUTHORS.

2864. Relation between Coefficients of Depolarisation of Light Diffused by a Suspension. A. Boutaric and J. Breton. *Rev. d'Optique*, 17. *pp.* 401–406, *Nov.*, 1938.—The relation $\rho_n = (x - {}^1/\rho_h)/(1 - x/\rho_v)$ of Krishnan [see Abstract 2990 (1935)] between the coefficients of depolarisation ρ_n, ρ_v, and ρ_h of the light diffused by a suspension at 90° to the incident beam of natural light, and of the light polarised vertically and horizontally respectively, should give $x = 1$ if the suspended particles are not subjected to orientation. This has been tested and found correct for colloidal solutions of As_2S_3, $Fe(OH)_3$, and mastic and for suspensions of "argile" and bentonite. Calculation of x from the measurements of Krishnan [see Abstract 2009 (1938)] on a graphite suspension subjected to a magnetic field shows that when the field is perpendicular to the incident beam and to the direction of observation $x = 1$, but when the field is parallel to the direction of the incident beam, or the direction of observation, x differs greatly from 1. Further, x varies with the wave-length of the incident lights (As_2S_3 and $Fe(OH)_3$ suspensions), and with the pH of the suspension (casein). W. R. A.

2865. Influence of Secondary Scattering on Depolarisation Measurements. R. S. Krishnan. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 303–308, *April*, 1939.—It is pointed out that in emulsions and protein solutions in which the scattering is very intense, the secondary scattering has a marked influence on the depolarisation factors. The values of ρ_u, ρ_v and ρ_h are in general enhanced, due to the presence of secondary scattering in the solution. The effect of secondary scattering on the depolarisation factors could be eliminated by illuminating the colloidal solution by means of a very narrow pencil of light and then measuring the depolarisation factors by the Cornu method. AUTHOR.

2866. Scattering of Light by Large Water Drops. Parts I and II. G. R. Paranjpe, Y. G. Naik and P. B. Vaidya. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 333–364, *April*, 1939.—Part I contains detailed calculations of the intensity and polarisation of light-scattering by large water drops particularly from the point of view of the angular distribution of intensity and its dependence on the particle sizes. Part II covers the experimental investigation and it is found that, in general, good agreement is found between theory and experiment. It is noticed, however, that the quantitative agreement is much closer in the forward than in the backward direction. The experiments bring out clearly that it is essential that the size of the spheres must be all the same and that the particles must not be so dense as to give rise to multiple scattering. A. H.

2867. Effect of Temperature on Wings Accompanying Rayleigh Lines in Liquids. K. Bapayya. *Indian Acad. Sci., Proc.* 9A. *pp.* 404–409, *May*, 1939.—Different portions of the continuous wings exhibited by chloroform and benzene are found to be depolarised to the same extent, namely 0·86, both at room-temperature and high temperatures. Depolarisation of the total scattering in benzene diminishes from 0·44 at room-temperature to 0·11 at 260° C. The intensity of the central portion of the wing increases in these two liquids in both the horizontal and vertical components, with increasing temperature relatively to the inner and outer portions. AUTHOR.

2868. Scattering of Light in Stretched Rubber. H. A. Schwarzenbach. *Helv. Phys. Acta*, 12. 3. *pp.* 270–276, 1939. *In German.*—It is shown that when a rubber membrane, stretched in one direction, is irradiated with parallel rays from a carbon arc and when the surface effect is eliminated, a pattern is produced in which the scattered light forms three bands intersecting in a point; one band being perpendicular to the direction of stretch while the other two are inclined to it on either side at equal angles. The angle between these latter and the direction of stretch increases as the amount of stretch increases. The polarising microscope shows that there are three directions in the rubber which are perpendicular respectively to these three bands of scattered light. G. O. B.

See also Abstracts 2742, 2891, 2960, 2961.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2869. Photographic Definition. F. P. Liesegang. *Phot. Indust.* 37. *pp.* 543–545, *May* 3, 1939.—Photographic definition has been shown to depend on two laws [see Abstract 86 (1911)]. Examination of the formal expression of these laws shows that the general expression for definition is determined by the numerical relations between a number of single factors. Two diagrams are given involving various factors, such as aperture, focal length and diameter of the dispersion circle, and from these simple numerical relations are derived between definition and focusing when the aperture is varied stepwise and also for stepwise variation of the focusing. A. W.

2870. Use of Hexamethylenetetramine in Photographic Developers. A. Seyewetz. *Soc. Franç. Phot. et Ciné, Bull.* 1. *pp.* 85–90, *April*, 1939.—Briefly discusses the use of hexamethylenetetramine as an alkaline substance for use with developers, and examines the developing properties obtained when it is mixed with phenolic developers. It is found to act as a weak alkaline substance similar to ammonium carbonate, but less effective than borax, and its action rapidly reaches a maximum value, above which it remains constant. Although this compound only appears to be used with paraphenylenediamine fine-grain developers, its great solubility in water, its constancy in air, and the absence of any calcareous precipitation with tap-water make it worth while using in a number of other developers. R. C. F.

***2871. Sensitometer for Intensity Scales. C. Forch.** *Phot. Indust.* 37. *pp.* 490–491, *April* 19, 1939.—Briefly describes an apparatus in which the active sensitive-layer carrier is a logarithmic spiral, so arranged that the light enters through a thin plate of quartz with fine air capillaries through it, and placed at the pole of the spiral. Gradation curves obtained with the apparatus using a mercury-arc lamp are given. R. C. F.

2872. Reversible Polymerisation of Dyestuffs and its Significance for the Sensitisation of Photographic Plates. G. Scheibe, A. Schöntag, J. Kopske and K. Henle. *Zeits. f. wiss. Phot.* 38. *pp.* 1–13, *Jan.–March,* 1939.—Easily soluble salts of basic dyestuffs if in sufficient concentration frequently undergo reversible polymerisation with consequent change of absorption spectrum. H_2O plays an essential role in the process, whilst very small amounts of ethyl alcohol and of acetone are able to inhibit it. The polymer is a colloid with fibre form. The polymerisation, with change of absorption and consequent alteration in sensitising action, occurs also in the adsorbed state. A series of sensitising experiments have been carried out with $1 \cdot 5 \times 10^{-6}$ *M* solutions of pseudocyanine N–N′ diethyl chloride, and Agfa and Perutz plates. After short immersions, the plates showed the absorption band of the monomeric form at 5460 Å, *i.e.*, displaced 700 cm^{-1}. by adsorption; but 20–30 min. immersion yielded a new band at 5790 Å due to the polymerisation. The dyestuff thus diffuses through the gelatin to the AgBr grains covering them first with the monomer and later with the polymer. The monomer is more easily removed by washing than the polymer. S. J. G.

2873. Action of Corpuscular Rays on the Photographic Emulsion. H. Wambacher. *Zeits. f. wiss. Phot.* 38. *pp.* 38–61, *Jan.–March,* 1939.—A comprehensive review, with copious references, of work on the photographic effects of electrons, positrons, ions (electrically accelerated), protons, deuterons and tritons, neutrons, α-particles and mesotrons. Variation of the intensity of blackening with the energy of the electrons, the sensitivity of various types of plate and the effects due to the ionising and X-ray generating action of electrons is considered. Ions (canal rays) give image intensity characteristic of the frequency of occurrence of the isotope, and isotopes in the ratio 1 : 60000 can be detected side by side on the same plate. Following are the approximate photographic activities of the different types of ray: 1 X-ray quantum (0·5 Å) renders developable 1 AgBr grain, or 1000 Ag atoms; 1 α-particle from Ra (6×10^6 eV) 10–15 grains or 50000 Ag; 6–8 β-particles (10^5–10^6) V, 1 grain; 1 electron (10^4 eV), 2 grains; canal rays (800 eV) 10^4 ions per grain. Pinacryptol yellow—usually a desensitiser—sensitises plates towards H-rays. Neutrons have no direct photographic action, but act indirectly in that they liberate (photographically active) protons from the gelatin. Application of photographic methods to determination of α-particle range from radioactive materials and to detection of mesotrons is discussed. S. J. G.

2874. Empirical Relations between Sensitometric and Size-Frequency Characteristics in Photographic Emulsion Series. A. P. H. Trivelli and W. F. Smith. *Kodak Research Lab., Comm. No.* 699. *Phot. J.* 79. *pp.* 330–338, *May,* 1939.—Southworth gave a quantitative relation between the H. and D. speed and the gamma infinity of two series of commercial photographic emulsions, and this same relation also holds good for a number of emulsion series with different times of development after exposure. An emulsion series is a group of emulsions interrelated in such a way that quantitative relations in their sensitometric and size-frequency characteristics can be shown, and results of an examination of such characteristics are given. It is found that simple exponential functions exist between average grain size and the standard deviation of the grain size distribution, average grain size and average grain thickness, total number of grains per cm^3. of emulsion and the average grain size, total surface of the grains per cm^3. of emulsion and the average grain size, standard deviation and average grain thickness, total number of grains per cm^3. and the standard deviation, total surface of the grains per cm^3. of emulsion and standard deviation, gamma of the H. and D. curve and average grain size, and H. and D. speed and the total grain surface per cm^3. of emulsion. There is also a direct proportionality between time of precipitation of the Ag halide and average grain size, H. and D. speed and the average grain size, and H. and D. speed and time of precipitation of the Ag halide. R. C. F.

2875. Optical Sensitising of Silver Halides by Dyes. Part II. Mechanism of Optical Sensitising and the Quantum Equivalent. S. E. Sheppard, R. H. Lambert and R. D. Walker. *Kodak Research Lab., Comm. No.* 719. *J. Chem. Phys.* 7. *pp.* 426–436, *June*, 1939.—The photolysis of AgBr sensitised with certain acid and basic dyes has been followed by chemical and photometric determination of the Ag produced. It was found that in the absence of halogen acceptors the dye is progressively bleached, but in the presence of halogen acceptors it is recovered chemically unchanged. However, the dye actually combines with the bromine released but is regenerated on giving up the bromine to another less active acceptor. The maximum of sensitivity is found to occur considerably before adsorption-saturation, and at about the same adsorption-density for both photolysis and photographic sensitivity. The apparent desensitising action of sensitising dyes at higher adsorption-densities is ascribed to the facility of rebromination by the dye : Br addition compound. So long as the photographic yield is proportional to the adsorption-density of the dye an initial quantum equivalent of unity is found—one quantum of light absorbed by the dye produces one Ag atom. In regard to the mechanism of sensitising, photovoltaic experiments indicate the release of photoconductance electrons. These may be emitted either by the adsorbed dye itself or by bromide ions of the AgBr receiving energy from the photoactivated dye. Some indirect evidence supports the latter view. [For Part I see Abstract 2067 (1939).]
AUTHORS.

2876. Reversal Effect with Photolytic Silver. H. Arens. *Zeits. f. wiss. Phot.* 38. *pp.* 28–37, *Jan.–March*, 1939.—A number of reversal phenomena are known to occur with photolytic Ag in the latent image, *i.e.*, before development. If original exposure occurs in presence of certain "acceptors," which are then removed by washing, subsequent exposure leads to a reduction in the intensity of the developed image. In the present work $NaNO_2$ was the acceptor, the emulsion containing 0·5 gm. $NaNO_2$, 5·6 gm. gelatin and 1·8 gm. Ag per 100 cm^3. The film was exposed to light, washed 16 hours in H_2O, dried, and then re-exposed. With strong first exposure, the plate becomes markedly brighter on second exposure, yet the quantity of Ag per cm^2. *increases*, while the number of grains decreases. Thus the Ag which first separated in presence of $NaNO_2$ aggregates into larger particles under the influence of the second exposure in absence of $NaNO_2$. S. J. G.

2877. Colour Photography on Paper. R. Auvillain. *Soc. Franç. Phot. et Ciné., Bull.* 1. *pp.* 90–93, *April*, 1939.—Briefly describes the "Duxochrom" method for reproducing colour photographs on paper. Three coloured negatives, as with the carbon process, are required, these being on transparent bases, and the images are then transferred, after treatment, to a gelatined paper. The transparency of the supporting medium enables correct juxtapositioning. Details of the various steps in the processes are given, some of which must be adhered to exactly if satisfactory results are to be obtained. R. C. F.

2878. Principles of Dufaycolor Printing. G. B. Harrison and R. G. Horner. *Phot. J.* 79. *pp.* 320–329, *May*, 1939.—When it is desired to make a copy of the original colour picture as obtained by exposure in the camera, two difficulties are encountered. Desaturation of all the colours occurs if simple projection, or contact printing, is tried, and, owing to the regular structure of the Dufaycolor reseau, interference shows itself in the form of a moiré pattern. The means adopted by the authors to avoid the desaturation of the colours, and to remove the moiré pattern are discussed in detail, and finally the optical systems for printing kinefilm and roll films are described. R. C. F.

See also Abstracts 2681, 2920, 3016.

PHOTOMETRY.

2879. Visual Photometry of Sodium Lamps using Colour Filters. H. König. *Helv. Phys. Acta*, 12. 3. *pp.* 229–248, 1939. *In German.*—The errors introduced in the visual (and physical) photometry of Na lamps by the use of filters of various kinds in combination with a W lamp are investigated experimentally. It is concluded that neither the Schott yellow filter (OG 2) nor the Wratten combination 23A + 57 give accurate results with a small number of observers. The best solution is obtained with a combination of filters, using the difference between the transmission of an orange-red filter and that of a red filter. The measurement is therefore carried out by means of two comparisons in one of which yellow is measured against red and in the other, yellow against orange-red.

J. W. T. W.

POLARISATION.

***2880. Theory of Cornu Polarimeter. W. Smosarski.** *Gerlands Beitr. z. Geophys.* 54. 3. *pp.* 235–244, 1939.—The intensities of the two beams traversing the Wollaston-Nicol prism system of the Cornu polarimeter are calculated. The precision with which they can be made equal (zero setting) depends on whether analyser (Nicol) or polariser (Wollaston) is rotated to make this adjustment. By suitable use of the prisms, measurements can be made even when the polarisation is small, or the light is faint, or the colours of the two polarised rays are different.

C. B. A.

2881. Optical Properties and Structure of Cyano-Camphor. J. P. Mathieu and M. Ronayette. *Comptes Rendus*, 208. *pp.* 1567–1569, *May* 15, 1939.—The absorption spectrum, circular dichroism and rotatory dispersion between 6000 and 2500 Å are measured for cyano-camphor in various solvents. The rotatory power is not constant, and assumes increasingly positive values with time before reaching a constant value which depends on the solvent. It is controlled by the carbonyl absorption band at 2900 Å. The curve of circular dichroism inside this band has three maxima, and can be represented by the sum of three terms of the Lowry-Hudson type. The rotatory dispersion in the region of absorption can also be calculated satisfactorily on this basis. The Darmois diagram suggests the presence of two isomeric forms of the molecule, and an $\alpha \rightarrow \alpha'$ transformation is suggested as the cause of mutarotation.

C. B. A.

2882. U.V. Rotatory Dispersion and Circular Dichroism of Santonide and Parasantonide. S. Mitchell and K. Schwarzwald. *Chem. Soc., J. pp.* 889–893, *May,* 1939.—Both santonide and parasantonide show the Cotton effect associated with a strong ketonic band which in alocholic solution has its head at about 3000 Å. For santonide $\epsilon_{\max.} = 1000$ and for parasantonide $\epsilon_{\max.} = 1170$, but despite these large values it has been possible to take rotation readings right through the band in each case. The specific rotation of santonide reaches +25,500° on the long-wave side of the band, and − 31,000° on the other side. For parasantonide the corresponding values are even larger, being + 32,000° and − 35,000°, respectively. The latter values are remarkable, as they are about ten times the normal, and about three times the value (+ 11,000°) obtained by Kuhn and Biller for the dimethylamide of methoxyphenylacetic acid, which has the largest specific rotation hitherto measured in homogeneous solution. The maxima of circular dichroism $(\epsilon_l - \epsilon_r)$ are also abnormally large, but the anisotropy factors $(\epsilon_l - \epsilon_r)/\epsilon$ have normal values which average 0·030 and 0·038 for santonide and parasantonide, respectively. AUTHORS.

See also Abstracts 2753, 2755, 2864, 2865, 2867, 2918, 2963.

REFLECTION, REFRACTION AND DISPERSION.

***2883. Chemical Silvering of Glass. S. Miyagi.** *Electrot. Laborat. Tokyo, Japan, Circ. No.* 112. [63 *pp.*], 1938.—The contents of this report are as follows : Outline of process for chemical silvering of glass ; formulæ of silvering solutions ; cleansing and pretreatment of the surface to be silvered ; chemical conditions in the formation of mirrors ; protective substances in silvering solutions ; physico-chemical factors affecting the formation of mirrors ; coating for the silvered surface ; physical properties of the silvered surface ; reference papers and patents. AUTHOR.

2884. U.V. Reflectivities of Evaporated Metal Films. G. B. Sabine. *Phys. Rev.* 55. *pp.* 1064–1069, *June* 1, 1939.—The reflectivities of evaporated metal films from the visible to 450 Å have been determined for the following metals : Al, Sb, Be, Bi, Cd, Cr, Cu, Au, Fe, Pb, Mg, Mn, Mo, Ni, Pd, Pt, Ag, Te, Ti, Zn and Zr. Photographic methods were used. From the visible to 2400 Å, a quartz mercury arc with calibrated wire screens and a quartz prism spectrograph were employed. From 2400 to 450 Å it was necessary to use a vacuum spectrograph with grating, a discharge tube, and oiled photographic film. The accuracy of the work in the near u.v. is of the order of 3% and in the far u.v. not better than 5%. Curves of reflectivity against wave-length for these metals are included. AUTHOR.

2885. Calculation of Seidel Sums. S. Maruyama. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 149–155, *April,* 1939. *In English.*—A useful method in the correction of aberrations or the investigation of the properties of an optical system involves the calculation of Seidel sums. A simplified method of calculating these is put forward. A. H.

*** 2886. Resolving Power and Distortion of Typical Aeroplane-Camera Lenses. F. E. Washer.** *Bureau of Standards, J. of Research,* 22. *pp.* 729–746, *June,* 1939.—Tabulations are given of the resolving power and distortion of a number of aeroplane-camera lenses of the type most commonly used in recent air-mapping projects. Since the image plane of best average definition does not necessarily coincide with the image plane yielding best definition on the axis of the lens, the method of selecting the image plane of best average definition and its use in connection with the determination of the equivalent focal length are described. The manner of the variation of the resolving power across the field is characteristic of the type of lens. AUTHOR.

2887. Relation between Refractive Index and Surface Tension. V. Biano and D. Téodoresco. *Soc. Roumaine de Physique, Bull.* **39**. 72. *pp*. 73–78, 1938. *In French*.—By using the formulae of McLeod and of Gladstone (or that of Lorentz-Lorenz), the authors have obtained a relation between the refractive index and the superficial tension. This relation enables the value of the superficial tension to be obtained for different temperatures not too near the critical point. The authors have verified their relation for some liquids, the erorr being less than 0·5%. AUTHORS.

2888. Law of Mixtures. D. Téodoresco. *Rev. d'Optique*, **17**. *pp*. 394–400, *Nov.*, 1938.—Using the relation between refractive index and specific volume of a liquid, the author expresses the mean coefficient of expansion between two temperatures as a function of the corresponding refractive indices. Applying the result to a binary mixture, an accurate relation is found for calculating the refractive indices of the mixture at various temperatures without knowing the corresponding densities. F. S.

2889. Refractive Indices and Molecular Refractivities of 3-Methylcyclohexanone and Pulegone. D. M. Simpson. *Chem. Soc., J. pp*. 886–889, *May*, 1939.—Refractive indices over a wide range of wave-lengths in the visible and the u.v. region, including those covered by the ketonic absorption band at about 3000 Å, are recorded for pulegone and for 3-methylcyclohexanone. The refractivities of the carbonyl radical in each compound are deduced and compared with those previously recorded for this radical in cyclohexanone. An enhanced molecular refractivity in pulegone, which might be described as an " optical exaltation " in view of the conjugation of carbonyl and ethylenic double bonds, cannot be attributed to the presence of an absorption band which does not appear in the spectra of the other compounds, since equally abnormal values are obtained for 3-methylcyclohexanone, to which this explanation cannot be applied. It is concluded that these effects result from the invalidity of the additive relationship in the presence of strongly chromophoric radicals, as predicted in a previous paper. [See Abstract 189 (1938).] AUTHOR.

*** 2890. Double Refraction and Turbulence of Liquids in Motion. W. Buchheim and H. A. Stuart with H. Menz.** *Zeits. f. Physik*, **112**. 7–8. *pp*. 407–419, 1939.—Kundt's method of confining the liquid to an annulus between co-axial cylinders, of which the outer is rotated is used. The velocity gradient is then given by $q = 2\pi r N(1 + R^2/d^2)/(R^2/r^2)(R - r)$, where N is the number of revolutions per sec., and d the distance of the point concerned from the axis. A 500 W high pressure Hg vapour lamp is used as the source of light with filter to give the monochromatic green Hg line, and pressure filtration and repeated filling is required to remove dust from the liqud. Special attention is given to the effect of turbulence on double refraction, it appears that some of the older measurements above the turbulence point are vitiated ; the initiation of turbulence can easily be observed with liquids giving large double refraction. Anomalies in the extinction of benzol derivatives reported by other authors are not confirmed. The Maxwell constant $(\Delta n/q.n.\eta) \times 10^{10}$ for $\lambda = 0{\cdot}546\mu$ has the following values : *o*-dichlorobenzol 1·85, *p*-xylol 1·84, mesitylene 1·31, *m*-xylol 1·29, chlorobenzol 1·22, *o*-xylol 1·22, toluol 1·04, phenyl-ethyl alcohol (*primary*) 0·67, benzol 0·64, heptyl alcohol (*primary*) 0·41, carbon tetrachloride $<0\cdot06$, cyclohexane $<0\cdot03$. The double refraction $(\Delta\lambda)$ is found to be proportional to velocity gradient within the limit attained of 4300/sec., values of $(R - r)$ of 0·39, 1·59, and 2·6 mm., with $R = 50\cdot3$ mm. were used, the path of light being 150 mm. The quantity $(1 + R^2/d^2)/(1 + R^2/r^2)$ varies slightly with d. D. R. H.

2891. Superficial Deformation of Chilled Glass. N. Winter-Klein. *Rev. d'Optique,* 17. *pp.* 377–393, *Nov.,* 1938.—By the use of interference fringes, permanent deformation of the surfaces of chilled glass specimens has been observed. The surfaces of annealed specimens have been found invariable. The form of the surface has been observed at temperatures up to 100° C. and also at a fixed temperature for a period of 3 months. The observed deformations vary with the diameter chosen for observation and correspond with variation of refractive index. F. S.

2892. Fine Structure of Glasses. Part II. E. Kordes. *Zeits. f. phys. Chem.* 43. *Abt. B.* 2. *pp.* 119–152, 1939.—It is found the molecular refraction increases by constant increments as atoms are added. These increases can be predicted for particular structures or particular polarisation effects. In the system $P_2O_5 - PbO$ the refraction can be calculated from theoretical values of molecular volume and molecular refraction and good agreement with experiment obtained as far as 61% PbO. F. S.

See also Abstracts 2753, 2755, 2763, 2837, 2863, 2921.

SPECTROSCOPY.

2893. Spark Spectrum of Ag in Vacuo. L. Bloch, E. Bloch and Li Kouang-Tao. *Comptes Rendus,* 208. *pp.* 1214–1216, *April* 17, 1939.—The spectrum of the spark between Ag electrodes *in vacuo* was found to be very different from that of the Ag spark in air, especially in the visible where a much richer spectrum is obtained. Between 6800 and 2300 Å more than 1000 new lines were measured. By electrical control of the spark, the lines of Ag I, Ag II, Ag III and Ag IV could be clearly distinguished. The presence of continous spectrum in the spark spectrum studied shows that the explanation of the continuum in the spark spectrum in air as arising from foreign gases is incorrect. W. S. S.

***2894. Observation of Feeble Spectral Lines near Intense Lines. A. Couder and P. Jacquinot.** *Comptes Rendus,* 208. *pp.* 1639–1641, *May* 22, 1939.—Consideration of the diffraction pattern of the image of the spectrograph slit shows that the masking of a feeble spectral line by the proximity of an intense line should be minimised if the length of the slit is so reduced that it becomes practically a point source, and if the object glass is fitted with a square diaphragm whose diagonal is at right angles to the axis of dispersion. Quantitative experiments to check this conclusion are described, and show that considerable gain is actually obtained. D. H. F.

2895. Intensity of He Spectrum as Function of Pressure with Admixture of H_2 or Hg Vapour. O. Masaki, T. Morita and K. Kobayakawa. *Hirosima Journ. Sci.* 9. *pp.* 105–113, *March,* 1939. *In German.*—The measurements cover the 14 most prominent lines of the He spectrum in the range 3889 to 6678 Å as emitted from a Geissler tube for He pressures between 0·1 and 5mm. and with traces of admixed H_2 and Hg vapour. In the case of all lines excepting λ 6678 $(2_1P - 3_1D)$ the intensity is a maximum at about 1 mm. pressure, the intensity is decreased by admixture of H_2 and by admixture of Hg vapour, in the former case the position of the maximum remains substantially unchanged at about 1 mm. and in the latter case it is displaced to higher pressures. In the case of 6678 Å the intensity is increased by admixture both of H_2 and Hg. The observations are explained on the basis of collisions of the first and second kind between normal and excited He atoms and atoms of the admixed gas. J. E. K.

2896. Simple Construction of Rotation-Broadened Lines. P. Wellmann. *Zeits. f. Astrophysik*, 18. 2. *pp.* 142–145, 1939.—A simple graphical method is given for deriving the contour of a rotation-broadened spectral line when the stationary contour and rotation velocity are known. The method is an extension of one given by Unsöld and is applicable to cases in which the rotation width is up to 8 times as big as the half-value width of the unbroadened line. J. E. K.

2897. Symmetry Properties of Variational Functions. H. M. James and A. S. Coolidge. *Phys. Rev.* 55. *pp.* 873–874, *May* 1, 1939.—In an earlier treatment of the S ground state of Li [see Abstract 2729 (1936)] variational functions were employed which, it has since been noticed, were not of pure doublet symmetry. The significance of this fact is now discussed and, also, the general rôle which such symmetry properties play in the variational treatment of atomic systems. A. H.

2898. Calculation of Proper Function and Energy of Ground State of Valency Electrons in Alkali Atoms. P. Gombás. *Ann. d. Physik*, 35. 1. *pp.* 65–72, *May*, 1939.—By means of a variational treatment, which does not involve the use of empirical or semi-empirical parameters, a method of calculating the proper function and energy of the ground state of the valency electrons in free alkali atoms has been developed and is applied to K and Rb. [See Abstract 711 (1939).]

W. R. A.

2899. Infra-Red Absorption Spectra and Molecular Linkages. R. Freymann. *J. de Physique et le Radium*, 9. *pp.* 517–524, *Dec.*, 1938, *and* 10. *pp.* 1–6, *Jan*, 1939.—The infra-red evidence for intra- and intermolecular H-linkages is reviewed, with particular reference to bands between 0·8 and 1·2 μ. The OH bands are first studied. They are divided into two classes, one corresponding to non-associated and the other to associated groups. The bands become doubled under the influence of intra-molecular $C-Cl$, $C-Br$, etc., or of intermolecular $C=O$ or $C=C$. It is suggested that information on the hydrogen bond could be obtained from measurements between 6 and 10 μ, where deformation frequencies of OH occur. The problem of the hydrogen bond is then reviewed, and detailed spectroscopic evidence for the linkages $O-H \leftarrow O$ and $O-H \leftarrow N$ is given. An extensive bibliography is included.

C. B. A.

2900. Far Infra-Red Absorption Spectra of Mono-Substituted Products of Benzene. P. Barchewitz and M. Parodi. *Comptes Rendus*, 207. *pp.* 903–905, *Nov.* 14, 1938.—The diffusion and absorption spectra of PhX ($X =$ H, Me, NH_2, CN, OMe, NO_2, Cl, Br, I) have been observed from 17 to 55 μ. The wave-lengths of the bands, which are attributed to ω_1, ω_2, ω_{10}, and ω_{12} vibrations, are recorded. [See Abstract 1666 (1938).] W. R. A.

2901. Infra-Red Absorption Spectra of Mono-Substituted Derivatives of Naphthalene. J. Lecomte. *Comptes Rendus*, 208. *pp.* 1636–1638, *May* 22, 1939.—On passing from naphthalene (centre of symmetry, symmetry D_{2h}) to α- and β-mono-substituted derivatives (plane of symmetry through the molecule) a correspondence is predicted between the infra-red absorption, diffusion and Raman spectra. The infra-red absorption spectra have therefore been observed of α- and β-$C_{10}H_7X$ (X = OH, NH_2, CH_3, Cl, Br, I), α-$C_{10}H_7NO_2$ and β-$C_{10}H_7CN$. In these spectra the frequencies of the naphthalene molecule (obtained by absorption or diffusion) reappear with relatively small displacements. α- and β-isomers have series of lines of frequencies sufficiently different to be distinguished. The absorption spectra contain many more lines than those recorded for the Raman spectra. This is explained as due to effects such as fluorescence. W. R. A.

2902. Infra-Red Absorption Spectra of H_2O and CO_2. F. Schnaidt. *Gerlands Beitr. z. Geophys.* 54. 3. *pp.* 203–234, 1939.—Recent measurements of the fine structure of the absorption of H_2O and CO_2 in geophysically important regions of the spectrum are described, with special reference to the effects of temperature and pressure. A method is sought for reducing the complex infra-red spectra of these molecules to equivalent " rational " spectra. The most important reasons for line broadening are discussed on the basis of the so-called dispersion form of the lines, and a simple construction is derived by which the total absorption at any temperature and pressure can be obtained from the normal absorption. Comparison with observation shows poor agreement, but discloses another effect which makes the definition of an " effective water-vapour density " imperative. Values of the total line absorption are tabulated for different densities and half-breadths, and with their help and the measurements of Falckenberg the required rational spectra are obtained. A. Hu.

2903. Vibrational Analysis of CCl Bands. T. Horie. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 143–148, *April*, 1939. *In English*.—The band-spectrum of CCl in emission has been obtained by means of condensed discharge through continuous flow of CCl_4 vapour. Its vibrational structure has been investigated. The heads are represented approximately by

$$\nu_h = \left\{\begin{matrix} 35756\cdot 5 \\ 35852\cdot 4 \end{matrix}\right\} + 953\cdot 6v' - 18\cdot 8v'^2 - 861\cdot 1v'' + 3\cdot 5v''^2.$$

The transition is probably $^2\Sigma \rightarrow {}^2\Pi$. AUTHOR.

2904. Influence of Temperature and Coupling on the Intensity of Infra-Red Harmonics. F. Matossi. *Phys. Zeits.* 40. *pp.* 323–331, *May* 1, 1939.—The deviations observed in the intensity of the infra-red harmonics of the silicates are accounted for by a mathematically developed dispersion theory based on the coupling of adjacent oscillators. It is deduced that (*i*) the intensity of harmonics depends on the degree of coupling; when common atoms of both oscillators are coupled, as in the silicates, a weakening of the octave occurs, (*ii*) both components of the octave (arising from the coupling) have different intensities, and (*iii*) the absorption coefficient k in the vicinity of the octave increases with temperature. From the displacements of the maxima of k with temperature the constant of the anharmonic linking has been calculated. W. R. A.

2905. Infra-Red Absorption Spectra of Solids by the Powder Method. J. Lecomte and R. Freymann. *Comptes Rendus*, 208. *pp.* 1401–1403, *May* 1, 1939.—A method of examining thin layers of finely powdered solids deposited on rock-salt or KBr is outlined. It is capable of being employed with many different types of solids, those which decompose on fusion, water-soluble and water-insoluble solids, and solids containing water of crystallisation. Data are given for acetic acid and 11 metallic acetates, 3 metallic formates, oxalic acid (hydrated) and 4 metallic salts, 3 metallic acetylacetonates, $CuSO_4$ and $CuSO_4 \cdot 5H_2O$. W. R. A.

2906. U.V. Absorption Spectra of Vapours of Salicylic Acid and Lithium Salicylate. Choong Shin-Piaw. *Comptes Rendus,* 208. *pp.* 1563–1565, *May* 15, 1939.—The vapours of salicylic acid and lithium salicylate have three absorption ranges in the u.v. The vapour of the salt is not so stable as that of the acid, as bands due to phenol appear at 130°, and increase in intensity with further rise in temperature. The absorption spectrum of the acid and lithium salt are almost identical. The spectra are compared with those of the same substances in solution [see Abstract 2534 (1939)]. The existence of the B band in the absorption spectrum of the vapour is in agreement with the hypothesis formerly put forward that its disappearance in aqueous solution is a consequence of ionisation. A. J. M.

2907. Absorption Spectra of Naturally-Occurring Naphthaquinones and their Derivatives. R. G. Cooke, A. K. Macbeth and F. L. Winzor. *Chem. Soc., J. pp.* 878–884, *May,* 1939.—The absorption spectra of lapachol and lomatiol are in close agreement with that previously recorded for phthiocol and their derivatives of authentic 1 : 4- and 1 : 2-naphthaquinone structure show maxima characteristic of α- and β-naphthaquinones. The recently isolated colouring matter, dunnione, gives an absorption curve characteristic of a β-quinone and similar to that of dehydro-iso-β-lapachone, the structure of which is analogous to that proposed for dunnione by Price and Robinson. The effect of $\alpha\beta$-unsaturation in the side chain expressed itself in the absorption of the naphthaquinones examined in the replacement of the band due to $C{=}C{\cdot}\dot{C}O$ (λ *ca.* 3330) by an inflexion at the same location, and by displacement towards longer wave-lengths of the long-wave-length bands. The absorption spectrum of dehydrolapachone, although favouring the β-quinonoid structure, is, like the chemical evidence available, not strictly discriminative. AUTHORS.

2908. Band Spectrum of HS. M. N. Lewis and J. U. White. *Phys. Rev.* 55. *pp.* 894–898, *May* 15, 1939.—The absorption spectrum of HS is obtained by passing repeated flashes from a source of continuous background through a discharge tube in which HS radicals are formed from H_2S by pulses of radio-frequency current synchronised to precede immediately the flashes. The spectrograms obtained show only one band at 3237 Å. The rotational structure indicates that the ground state is an inverted $^2\Pi$, and the excited state a $^2\Sigma$. Because of the strong $\Lambda\Sigma$ coupling in the $^2\Pi$ state the doublet is wide, and since the Boltzmann factor greatly favours $^2\Pi_{3/2}$, only the strongest branch, Q_2, from the $^2\Pi_{1/2}$ state is found. From $^2\Pi_{3/2}$ the $^QP_{21}$ and $^RQ_{21}$ satellite branches as well as P_1, Q_1 and R_1 are found. For the $^2\Pi$ ground state the best values of the constants obtained are $B_0'' = 9{\cdot}47$; $D_0'' = -0{\cdot}001$ and $A = -378{\cdot}6$ cm^{-1}. The constants for the excited $^2\Sigma$ state are $B_0' = 8{\cdot}30$; $D_0' = -0{\cdot}00078$, and $\gamma = 0{\cdot}32$ cm^{-1}. The origin of the $0{\cdot}0$ ban is at $30659{\cdot}1$ cm^{-1}. AUTHORS.

2909. Structure of Ethylene. H. W. Thompson. *Faraday Soc., Trans.* 35. *pp.* 697–701, *June,* 1939.—Two bands in the absorption spectrum of ethylene have been analysed. One is a perpendicular type band and the other is of the parallel type. The analysis leads to values of the moments of inertia of the molecule which agree almost exactly with those previously suggested from other independent data. The determination of the molecular dimensions from the moments obtained is discussed in relation to previous work [see Abstract 4069 (1937)] and values finally adopted are $r_{CH} = 1 \cdot 085$ Å, $r_{CO} = 1 \cdot 331$ Å, $\widehat{HCH} = 118°$. AUTHOR.

2910. Energy Transfer in Elementary Collision Processes. H. Schüler and H. Haber. *Zeits. f. Physik*, 112. 9–10. *pp.* 614–625, 1939.—Previous investigations of variations of intensity distributions in band spectra emitted from cooled and uncooled hollow-kathode discharges [see Abstracts 1671 and 1679 (1939)] are extended and new intensity effects are observed in the spectra of BiH and AlH which throw further light on the collision processes leading to formation and excitation of the molecules. In the case of BiH it is found that there is a threshold temperature of the kathode surface above which the formation of molecules is hindered. From the different intensity distributions observed in the $(0 \cdot 0)$ and $(1 \cdot 1)$ bands of ${}^1\Sigma - {}^1\Sigma$ of BiH it is concluded that the collision efficiency for rotation with vibration is much greater than for rotation without vibration. The ratio of oscillation states does not vary over the possible pressure range of the hollow-kathode discharge. From observation of the spectrum of AlH in A it appears that in the same discharge space the distribution of rotational dates with vibration corresponds to a different Boltzmann temperature from the corresponding vibrationless distribution. J. E. K.

2911. Molecular Spectra of Hydrogen Isotopes. I. Sandeman. *Roy. Soc. Edinburgh, Proc.* 59. 1. *pp.* 1–14, *and* 2. *pp.* 130–140, 1938–1939.—The conditions under which the rotating-vibrator model may be employed in the study of the spectra of diatomic molecules are considered, and reasons are given for the view that in the regular Σ states of molecules of the H_2 type the model should give a good representation of molecular behaviour Measurements of some of the band systems of D_2 in the visible region of the spectrum are now available from the work of G. H. Dieke and his collaborators. Owing to the greater mass of the D_2 molecule its spectrum should provide better material for the application of the model than that of H_2. Like H_2, however, D_2 gives a spectrum in which lines corresponding to large values of the quantum numbers are not represented with measurable intensity. The result is that it is possible to fit the H_2 spectrum by a term form expressed as an expansion in powers of the quantum numbers with a greater number of coefficients of such powers. The model is consequently found to give a more-self-consistent fit for H_2 than for D_2. Difficulties raised by the practical application of the theoretical work of J. L. Dunham to the spectrum of D_2 are discussed, and the constants of the $1s\sigma 2p\sigma\,{}^1\Sigma$ and $1s\sigma 2s\sigma\,{}^3\Sigma$ states are calculated and compared with those for the corresponding states of H_2. It is shown that the potential functions of the isotopic states differ considerably, and that the equilibrium internuclear distance is greater for H_2 than for D_2 at least in the $1s\sigma 2p\sigma\,{}^1\Sigma$ state. The results of the analysis are sufficiently self-consistent to indicate that, in the case of these regular Σ states of the H isotopes, the rotating-vibrator model provides an accurate means of spectral analysis and opens up new avenues for investigation. In Part II an analysis of the $1s\sigma 2s\sigma\,{}^3\Sigma$ state of the three isotopes, H_2, HD, and D_2 (the last two from the measurements of Dieke and Blue (1935))has been carried out by the method of Dunham (1932), and it has been found: (1) that it is possible with an application of the ordinary mass-effect theory of molecular isotopes to represent the lowest-quantum term-differences of the three isotopic states with fair accuracy; and (2) that it is not possible so to represent the higher-quantum term-differences. Conclusion (1) implies that the internuclear distance in the three isotopic molecules cannot differ very much. Conclusion (2) implies that the potential functions of the three isotopes are different, and means in fact that the field of the deuteron differs appreciably from that of the proton. AUTHOR.

2912. Continuous Spectrum of Hg at High Pressure. R. Rompe, P. Schulz and W. Thouret. *Zeits. f. Physik*, 112. 5–6. *pp.* 369–376, 1939.—The intensity of the continuous spectrum was measured for pressures between $0{\cdot}5$ to $1{\cdot}5 \times 10^{20}$ atoms/cm^3. and for currents from 4 to 12 A. with a König-Martens spectrophotometer. There is an increase of intensity with current and an almost proportional increase with density, independent of the spectral region. This agrees with Unsöld's theory that the intensity is independent of the frequency emitted, is proportional to pressure and exponential with temperature. F. S.

2913. Infra-Red Luminescence of Rare-Earth Elements. M. Servigne. *Comptes Rendus*, 207. *pp.* 905–907, *Nov.* 14, 1938.—The kathode-luminescence spectra (from 6000 to 10000 Å) of Eu, Sm, and Dy compounds in solid solution with $CaWO_4$ are reproduced, and are compared with the spectra obtained in solid solution with $CaSO_4$. Nd, Tb, Ho, Er, and Tu give no characteristic emission. A new band system at approximately 9476 Å has been observed. [See Abstract 1191 (1937).] W. R. A.

2914. Intensities of the Stark Effect Components of Hydrogen. E. Gustafson. *Zeits. f. Physik*, 112. 7–8. *pp.* 453–463, 1939.—The dependence of the intensities of the Stark effect components of H on the field strength is calculated to a first approximation. The calculations are confined to transitions between the first states of H. The intensity variation is dependent in order of magnitude on the initial state. For the initial states 4, 3 and 2 and a field of 500 kV/cm. the symmetrical violet and red components show a mean asymmetry of $9{\cdot}5$, $4{\cdot}8$ and $1{\cdot}8\%$ respectively. J. E. K.

2915. Raman Spectra of Coordination Compounds. B. Roy. *Indian Journ. Phys.* 13. *pp.* 13–26, *Feb.*, 1939.—The Raman spectra of the two coordination compounds of $[Pt\ en_3]\ Cl_4$ and $[Pt\ en_2]\ Cl_2$ in aqueous solutions have been investigated and the frequencies and polarisations of the lines due to the vibrations of the complexes $[Pt\ (en)_3]$ and $[Pt\ (en)_2]$ have been determined. The frequencies obtained are

(*i*) for $[Pt\ (en)_3]$, $\Delta\nu = 284(D), 561(D)$ and $595(P)$ cm.$^{-1}$.

(*ii*) for $[Pt\ (en)_2]$, $\Delta\nu = 262, 387$ and 568 cm^{-1}.

It is shown that the results obtained are compatible with the predictions of the theory of valence bonds in this class of compounds, which was first developed by Sidgwick and later interpreted upon a quantum mechanical basis by Pauling and others. AUTHOR.

2916. Raman Spectra of Sodium and Potassium Molybdates, Crystalline and in Solution. E. Darmois and M. Théodoresco. *Comptes Rendus*, 208. *pp.* 1308–1309, *April* 24, 1939.—With excitation by 4358 and 4047 rays of Hg, results obtained with aqueous Na molybdate confirm those of Gupta [see Abstract 4275 (1938)]; in the doublet 897–839, the former is sharp and strong, the latter is a little weaker and wider. With the solid hydrated salt $Na_2MoO_4{\cdot}2H_2O$ the same double appears with the addition of 321. The neutral anhydrous molybdate of K is obtained by adding the theoretical quantity of KOH to ammonium paramolybdate, boiling off NH_3, and recrystallising. Its solution gives the same lines as does that of Na molybdate. On the other hand the crystals give a triplet 887–851–821 and a fourth line at 313. The first seems to correspond to the 897 of Na_2MoO_4, 851 and 821 to the diffuse 839 line.

The authors suggest that the spectra are due to the $(MoO_4)''$ ion hydrated or in the crystal lattice, and do not accept the suggestion of an octahedral arrangement, preferring a tetrahedron. [See also Abstract 4964 (1938).] D. R. H.

2917. Raman and Absorption Spectra of β-Tetralone and β-Indanone. D. Biquard. *Comptes Rendus*, 208. *pp.* 1096–1098, *April* 3, 1939.—Raman and U.V. absorption spectra of β-tetralone and of β-indanone have been studied. The lines for C = O in the Raman spectra of the β-isomers are much weaker than those for the α-isomers, presumably on account of the contiguity of the group to the phenyl ring in the former compounds. This is confirmed by a comparison of the u.v. absorption spectra. The Raman line is doubled in the case of β-tetralone. [See Abstract 3276 (1938).] C. B. A.

2918. Depolarisation Measurements on Raman Lines by Easy, Accurate Method. F. F. Cleveland and M. J. Murray. *J. Chem. Phys.* 7. *pp.* 396–400, *June*, 1939.—The depolarisation factors of Raman lines are determined by a method in which a Polaroid disc, so oriented that it passes light whose electric vector is horizontal, is placed between the Raman tube and the lens which condenses the scattered light on the slit of the spectrograph. Two exposures of equal duration are made, one with the arc below, the other with it at the side, of the horizontal Raman tube. The ratio of the intensities in the two exposures (depolarisation factor) is determined by comparison with the lines of seven argon spectra produced by argon light of known intensity ratios. Important advantages of the method are the comparatively short exposure times and the elimination of errors due to the polarisation characteristics of the spectrograph. Results for the depolarisation factors of Raman lines obtained from a mixture of benzene and CCl_4 are given and comparison with previous data for these compounds is made. AUTHORS.

2919. Molecular Association in Formic and Benzoic Acids. P. Koteswaram. *Zeits. f. Physik*, 112. 7–8. *pp.* 395–406, 1939.—The Raman spectra have been observed of formic acid at various concentrations in aqueous solution (95, 71, and 47·5%), and of benzoic acid at 200° in the molten state, and at 140° in saturated aqueous and benzene solutions. Increased dilution and increase in temperature causes a displacement of the maximum of the C = O band of formic acid towards higher frequencies. For benzoic acid the C = O displacement is higher in aqueous solution than in the molten state or in benzene solution. By analogy with acetic acid [see Abstract 3894 (1938)] and with H_2O and D_2O it is concluded that formic acid is highly associated in the liquid state and that solution in water (a polar liquid), or heating, causes it to dissociate to lower polymers. Data indicate that the behaviour of formic acid is not due to the formation of hydrates. W. R. A.

***2920. Illuminator for Visual Spectrum Line Densitometers. M. Slavin.** *J.O.S.A.* 29. *p.* 220, *May*, 1939.—Deals briefly with two changes made in a Gaertner densitometer used for the measurement of line densities in spectrochemical analysis [see Abstract 4214 (1935)]. Low intensity and poor colour match between the beam from the wedge and the beam from the spectrum line are removed by changing the illuminant from a 75 W incandescent lamp to a Hg-vapour lamp, and reducing the wedge range to 0 to 3·0 instead of the usual one of 0 to 4·0, enabling the whole of the wedge scale to be used. R. C. F.

✱2921. Improved 365-mμ Mercury Monochromat. E. M. Staats. *J.O.S.A.* 29. *pp.* 221–222, *May*, 1939.—A new two component 365-mμ monochromat, using the new optical filter glasses from the Jena Glass Works, has been designed and the properties of this are described. A. H.

See also Abstracts 2665, 2667, 2728, 2778, 2810, 2840, 2858, 2944, 2972 and

1560B. Quantitative Spectrum Analysis of Ferrous and Non-Ferrous Metals. F. G. Barker.

TRANSMISSION.

✱2922. Standardisation of Luminous Transmission Scale Used in Specification of Railroad Signal Glasses. K. S. Gibson and G. W. Haupt. *J.O.S.A.* 29. *pp.* 188–200, *May*, 1939. *Bureau of Standards, J. of Research*, 22. *pp.* 627–649, *June*, 1939.—This is the first of several papers dealing with the development and description of the signal glass specifications formulated by the Signal Section of the Association of American Railroads in 1935 and 1938. The present paper gives the spectral transmissions of the basic standards—red, yellow, green, blue, purple and lunar white glasses—on which the A.A.R. scale of luminous transmission is based, and defines that scale in fundamental, absolute units. Comparison is made with the scales defined in the 1908 and 1918 signal glass specifications. AUTHORS.

VISION.

2923. Temperature and the Critical Intensity for Response to Visual Flicker. Part III. W. J. Crozier and E. Wolf. *Nat. Acad. Sci., Proc.* 25. *pp.* 171–175, *April*, 1939.—Continuing previous work [see Abstract 2118 (1939), the authors measured the temperature shift of the critical flicker curve of the sword-tail and the platy, both of which give a curve with rod and cone branches. The temperature variation was found to be closely similar in both branches of the curve and for both fish. It is concluded that the chemical kinetics of the process of excitation must be the same in the four cases. On the other hand, the shapes of the critical frequency curves differ fundamentally and it would appear that shape is not determined by the nature of the chemical reaction of the excitation process but rather by the statistical distribution of the thresholds of individual receptor elements. [See following Abstract.] W. S. S.

2924. Specific Constants for Visual Excitation. Part IV. W. J. Crozier and E. Wolf. *Nat. Acad. Sci., Proc.* 25. *pp.* 176–179, *April*, 1939.—It is shown that for the hybrids of the sword-tail and platy there is hereditary transmission of the parameters determining the shape of the critical frequency curve [see preceding Abstract]. The temperature variation is the same as for the original genera. [For Part III see Abstract 1254 (1939).] W. S. S.

✱2925. Measuring Visibility under Preventable Glare. M. Luckiesh and L. L. Holladay. *J.O.S.A.* 29. *pp.* 215–217, *May*, 1939.—The authors have developed a transparent diffusing screen which, when illuminated by a distant light source D° from the normal to the screen, so scatters the light that an observer looking through the screen sees the field covered with a veiling brightness of intensity $2\cdot3E/D^{1\cdot8}$ foot-lamberts (E in foot-candles). Since previous investigations have shown that the effect of the light source on vision is similar to that of a veiling brightness of this amount, the special screen can be combined with the Luckiesh-Moss visibility to form an instrument for the direct measurement of glare. It is stated that the instrument gives results in agreement with earlier data obtained by Cobb and Moss on the effect of glare. W. S. S.

2926. Interpretation of le Grand-Geblewicz Phenomenon. A. Polack. *Comptes Rendus*, 208. *pp.* 1430–1433, *May* 1, 1939.—An explanation is put forward of the phenomenon discovered by le Grand and Geblewicz [see Abstract 329 (1939)] that an intense, rapidly flickering patch of coloured light loses its colour on being observed by indirect vision. It is suggested that each flash of the coloured patch is followed by a negative after-image of the complementary colour and that the two sensations are fused by the eye to give the impression of white. The absence of the phenomenon in direct vision is attributed to the greater duration of the positive after-image for that case. W. S. S.

See also Abstracts 3038, 3039.

X-RAYS.

***2927. Devices for Maintaining Constant Output of X-Ray Tubes. D. E. Lea.** *Brit. J. of Radiology*, 12. *pp.* 359–363, *June*, 1939.—Devices are described which automatically keep constant the output of an X-ray tube, as measured by an ionisation chamber. The compensation is made either by alteration of H.T. voltage or filament current, or in the case of ionic tubes by alteration of gas pressure. AUTHOR.

2928. Formation of True X-Ray Images by Reflection on Crystal Mirrors. L. v. Hámos. *Zeits. f. Krist.* 101. 1–2. *pp.* 17–29, 1939. *In English.*—It is shown that the inner surface of a crystal bent into a cylinder will act as a mirror for X-rays, exactly as a concave mirror will for visible radiation. The path of the X-rays is calculated and the condition for the formation of true images given. It is shown that the magnification depends on the position of the X-ray source relative to the crystal. The quality of the image is best when the object is nearest to the cylinder axis. The resolving power is calculated and shown to be limited more by the chromatic aberration than by the geometrical aberration. The effect of the chromatic aberration can be reduced by increasing the curvature of the crystal. G. O. B.

2929. Intensity-Distribution of White X-Radiation Reflected from a Crystal; with Note on Dispersion of Atomic Scattering Factor of Zinc near K-Absorption Edge. J. C. M. Brentano, J. Honeyburne and J. K. Berry. *Phys. Soc., Proc.* 51. *pp.* 668–682, *July*, 1939.—The reflection of the radiation emitted from an X-ray tube by a crystal in an X-ray goniometer gives origin to a pattern of lines standing on a general background. This background is constituted by white radiation emitted by the tube and regularly reflected from the crystal, and by radiation of different origins which has not been subjected to spectroscopic separation. The paper describes a method by which these two constituents of the background can be assessed separately, so that an accurate measurement of the intensity-distribution of the reflected white radiation becomes possible. This method is applied to examine the discontinuities of the background indicated [see Abstract 4586 (1937)] as a source of error in the evaluation of the intensities of reflection lines. Microphotometer records illustrating the conditions discussed in a previous paper are reproduced. The method is further discussed in its application to the determination of the dispersive change of the atomic scattering factor in the vicinity of an absorption edge; by its use *f* values for wave-lengths very close to the edge can be obtained. The results of experiments on the long-wave side of the zinc K-absorption edge are compared with the wave-mechanical dispersion curve. AUTHORS.

2930. Auger Effect and X-Ray Emission Spectra. A. Hautot and H. Sauvenier. *Comptes Rendus*, 208. *pp.* 1565–1566, *May* 15, 1939.—In attempting to explain certain anomalies in the emission spectra of Na, Al and Mg the authors use a formula proposed by Wentzel which includes the result of the occurrence of an Auger effect along with the transition producing emission. The broadening of the level $L_{II,III}$, calculated for Na by this formula is of the order of 0·1 eV which is in the region of the measured discrepancy. G. O. B.

2931. X-Ray Spectra of Ti and TiO_2. V. H. Sanner. *Zeits. f. Physik*, 112. 7–8. *pp.* 430–435, 1939.—The emission spectra excited by kathode- and X-radiation are investigated by means of a vacuum spectrograph ; the influence of chemical combination being established for the lines a_1, a_2, β_2, β_5, and β'_5. Absorption measurements are also reported and compared with those of other workers. D. R. H.

2932. L_{III} Absorption of I_2, Ba and Compounds of Ba. E. H. Green. *Phys. Rev.* 55. *pp.* 1072–1076, *June* 1, 1939.—The L_{III} absorption limits of solid I_2, metallic Ba, BaI_2, $Ba(OH)_2$, $BaBr_2$, BaH_2, $Ba(NO_3)_2$, BaO_2 and BaF_2 were examined with a two-crystal spectrometer. No secondary structure was detected in the I_2 limit. A very prominent absorption line was observed in the case of Ba and each of its compounds, and was in general more prominent in the compounds than in the pure element. In some of the compounds more or less pronounced secondary structure was observed, notably in the case of BaF_2. Pairs of curves were obtained showing the changes in this respect as the pure Ba absorbers were allowed to change in air to $Ba(OH)_2$. It is concluded that the L_{III} level of Ba is no wider than 4·06 V. The ratio *r*(III, M) is measured as 2·30 for Ba. AUTHOR.

2933. Azimuthal Intensity Distribution of X-Rays in the Potential Range 60-170 kV. S. Thordarson. *Ann. d. Physik*, 35. 2. *pp.* 135–146, *May*, 1939.—In investigating the distribution in azimuth of scattered X-rays a special tube is used which permits of accurate definition of the direction of incidence of the electron beam on the antikathode, and also of measurements in the angular region 0 to 90°. Al and W were used in the form of thin foils as antikathodes. Cu and Al were employed as filters. For the radiation most strongly filtered, the values of the angle for maximum scattered intensity agreed well with the values calculated theoretically by Sommerfeld in the region 60–110 kV. At potentials above 120 kV the observed values were less than the theoretical by amounts increasing to 7° at 170 kV. The deviation was attributed to the influence of diffusion in the antikathode. With increasing potential the ratio of the maximum intensity to the intensity at 90° increased. G. O. B.

See also Abstracts 2687, 2688, 2694, 2695, 2798, 3045, 3051 and 1645B. Problems of X-Ray Fluoroscopy. B. van Dijk.

HEAT.

CALORIMETRY.

***2934. Apparatus for Measuring Specific Heats of Gases Operating with Small Flow of Gas. L. Agostini.** *Comptes Rendus,* 208. *pp.* 1490–1492, *May* 8, 1939.—In order to determine the composition of a gaseous mixture flowing at a few mm³./sec. the following modification of the apparatus and method due to Blackett, Henry, and Rideal [see Abstract 2234 (1930)] was utilised. The gas was passed through a tube of iron heated at its two ends by a.c. so that they are both maintained at the same temperature. In the absence of any flow of gas the distribution of temperatures along the tube is the same from both ends and is symmetrical about the middle. When the gas passes this symmetry is destroyed. Between two points, equidistant from the middle there is a temperature difference which the author measures thermoelectrically and finds to be independent of the conductivity of the gas and proportional to the specific heat and its loss. The present method avoids the use of a.c. and the measurement is achieved by the changes of delicate thermoelectric forces of several μV measured by resistance changes. A Ni tube is used and the resistance changes are estimated by a Wheatstone's bridge circuit. Details are given of typical measurements to illustrate the delicacy of the arrangement and its advantage over the previous technique exemplified above. For a gas leakage of 12 mm³./sec. the changes in resistance can be measured with great accuracy. S. G. B.

2935. Thermal Properties of Liquid H_2. H. Gutsche. *Zeits. f. phys. Chem.* 184. *Abt.A.* I. *pp.* 45–58, 1939.—Comparatively few measurements have been made on the specific heats of liquid H_2. The specific heat at constant pressure has been measured over the temperature range 20°–40° K. and at pressures of 10–100 atm. The apparatus is fully described and is similar to that used by Kaischew on solid and liquid He. The results are given in graphic and tabular form and a value of $(\partial C_R/\partial p)_T$ is given as 0·68. Entropy values are calculated and a diagram is constructed. Expansion experiments were also carried out and the thermal effects were measured over the same pressure range. A list of references is included. E. H. D.

2936. True Specific Heat of Nickel above Curie Point. B. Persoz. *Comptes Rendus,* 208. *pp.* 1632–1634, *May* 22, 1939.—Determined by the author's method [see Abstract 2125 (1939)] the specific heat of Pt (c_p) between 0° and 1000° is given by the equation $c_p = 31{\cdot}2 \times 10^{-3} + 6{\cdot}29 \times 10^{-6}\,t$; that of Ni (99·51% pure) above the Curie point (358°) by $c_p = 0{\cdot}119 + 29{\cdot}2 \times 10^{-6}\,t$. These results agree well with other determinations, but the method is not satisfactory for ferromagnetic metals below the Curie point. C. A. S.

***2937. High-Temperature Vacuum Calorimeter of the Copper Block Type. L. G. Carpenter and A. R. Bryant.** *Journ. Sci. Instruments,* 16. *pp.* 183–192, *June,* 1939.—A form of metal block calorimeter is described in which the block may be at any temperature up to 500° C., the furnace which initially holds the specimen may be raised to any temperature up to 1000° C., and the whole apparatus is enclosed in an evacuated vessel. AUTHORS.

See also Abstracts 2693, 2745.

CONDUCTION.

2938. Problem in Heat Conduction. H. W. Woolley. *Phil. Mag.* 27. *pp.* 706–708, *June,* 1939.—The author points out an error in a paper by Green [see Abstract 79 (1937)]. The error occurs in the section on the wave-train method. In its corrected form, equation (27) of Green's paper is consistent with equation (33). S. W.

2939. Heat Transmission between Two Media. W. J. Walker. *Phil. Mag.* 27. *pp.* 765–768, *June,* 1939.—A contribution is made to the solution of problems in transverse heat transmission, in which the heat transmission is affected by the presence of an extraneous source or sink of large, but unknown capacity. The solution is derived by the assumption of a functional relation between temperature and length of duct for one of the media. AUTHOR.

2940. Thermal and Electrical Conductivities of Mg Alloys. R. W. Powell. *Phil. Mag.* 27. *pp.* 677–686, *June,* 1939.—Results are given for the thermal and electrical conductivities of eight Mg alloys at temperatures of 50°, 150°, and 250° C. It is shown that these results can be represented to within 3·5% by the equation $K = 0{\cdot}526 \times 10^{-8}\sigma T + 0{\cdot}027$, where K is the thermal conductivity expressed in gm.cal.cm^{-2}.sec^{-1}. for 1 cm. thickness and 1° C. difference in temperature, σ is the electrical conductivity expressed in reciprocal ohms per cm. cube, and T is the absolute temperature. An analysis is then made of existing data for the conductivities of Mg and its alloys, from which it is concluded that the equation $K = 0{\cdot}516 \times 10^{-8}\sigma T + 0{\cdot}022$ can be used to give an approximate value for the thermal conductivities of such metals. AUTHOR.

***2941. Thermal Conductivity of Coal and Coke. W. Fritz and H. Diemke.** *Phys. Zeits.* 40. *pp.* 361–366, *May* 15, 1939. *From the Reichsanstalt.*—Using two plate methods, one an absolute and the other a relative method, the thermal conductivities of 32 coal and 3 coke specimens taken from different German mines and coal districts have been measured. The thermal conductivity of coal is practically independent of the place of origin, increases with density as for an amorphous porous substance, and depends upon the composition. The variation of the thermal conductivity with direction and with temperature was also determined for one particular specimen of coal. Full details are given of the methods and apparatus employed. S. W.

CONVECTION.

See Abstract 2939.

DILATATION.

See Abstracts 2711, 2888.

TEMPERATURE.

***2942. Micro-Apparatus for Temperature-Time Curves, and a High-Temperature Thermostat. W. E. L. Brown.** *Journ. Sci. Instruments,* 16. *pp.* 195–199, *June,* 1939.—A thermopile is described with which "difference" curves can be taken, using alloy specimens weighing about 0·01 gm. contained in sealed silica tubes. The thermopile is used in a high-temperature thermostat furnace of which the windings form a resistance thermometer and a Wheatstone bridge. The furnace can be used either to maintain a constant temperature, or to give a steady rate of temperature change over a limited range. AUTHOR.

See also Abstracts 2942, 2943, 2957.

THERMOCHEMISTRY.

2943. New Method of Calculating Combustion Temperatures. H. Zeise. *Zeits. f. Elektrochem.* 45. *pp.* 456–463, *June*, 1939.—Special attention is given to mixtures of (alcohol vapour + H_2 + O_2) enthalpy, entropy, heat capacity and reduced thermodynamic potential of $C_2H_5 \cdot OH$ vapour being computed. D. R. H.

2944. Relations between Internuclear Distance, Force Constant, and Energy of Dissociation for C-C Linkages. J. J. Fox and A. E. Martin. *Chem. Soc., J. pp.* 884–886, *May*, 1939.—Combining a relation $D = k_e r_e^2/mn$, derived from a general potential function given by Sutherland, with $k_e r_e^5$ = const., it is shown that Dr_e^3 = const. for C-C linkages. When the ratio U/D is plotted against r/r_e a form of curve is obtained which applies to all such linkages. [See Abstract 754 (1939).] AUTHORS.

2945. Limits of Inflammability. H. F. Coward and G. W. Jones. *Bureau of Mines, Bull. No.* 279. [146 *pp.*], 1939.—After introductory pages, which deal with the conditions for the propagation of flame in mixtures of gases and the effect of various physical factors such as the source of ignition, pressure, temperature, turbulence, the effect of admixed inert substances, etc., a section is devoted to theoretical considerations. The major fact of the publication—about 120 pages—is then given over to a discussion of experimental values, which are given both in tabular and graphical form. All the important industrial inflammable products are included. The publication ends with a bibliography and index. G. G.

2946. Physics of Flames and Explosions of Gases. B. Lewis and G. v. Elbe. *J. of Applied Physics*, 10. *pp.* 344–359, *June*, 1939.—A general review of published work under the following headings; (1) self-ignition; (2) ignition by local sources; (3) flame propagation (flame front, spherical flames, stationary flames, influence of vessel shape and gas motion detonation, diffusion flames); (4) state of the burned gas; and (5) incomplete rotational excitation in diatomic gases at ordinary temperatures and pressure. L. A. W.

THERMODYNAMICS.

2947. Internal Pressure in a Liquid. M. F. Soonawala. *Indian Journ. Phys.* 13. *pp.* 31–41, *Feb.*, 1939.—The equation of state for water is derived under certain limiting conditions from thermodynamical considerations. The internal pressure is thence deduced. Values of compressibility are calculated, and compared with those observed. AUTHOR.

2948. Theory of Fusion. A. Harasima. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 156–165, *April*, 1939. *In English*.—A study is made of the partition function and of the equations of state of solid and liquid. By assuming a simple form of mutual potential-energy function S-like curves are obtained as in the van der Waals theory and the melting point determined by the condition of phase equilibrium. Lindemann's formula is derived. Change of density upon fusion is calculated. Further, thermal pressure in liquid is calculated and compared with the result previously obtained. [See Abstract 1442 (1938).] AUTHOR.

2949. Critical and Cooperative Phenomena. Part IV. Theory of Disorder in Solids and Liquids and Process of Melting. J. E. Lennard-Jones and A. F. Devonshire. *Roy. Soc., Proc.* 170*A*. *pp.* 464–484, *April* 21, 1939.—In Part III [see Abstract 1718 (1939)] a theory of melting was developed along the lines of Bethe's theory for short-distance order. In the present paper it is assumed that the environment of any one atom is governed by the average state of order throughout the assembly. The problem then becomes one involving long-distance order, to which a treatment of the Bragg-Williams type is applied. The following table shows how the present results obtained for A compare with those of Part III and observation.

Property	Part III	Part IV	Observed
Volume increase on melting at zero pressure	12·8%	13·5%	12%
Entropy change on melting at zero pressure	1·74k	1·70k	1·66k
Pressure of melting at 90·3°K. (dynes/cm².)	294×10^6	286×10^6	291×10^6
Coefficient of expansion (liquid)	0·0049	0·0040	0·0045

Reasonable agreement is also obtained for the properties of Ne, N_2 and CO, but not for O_2. It is shown that the theory gives a formula for the temperature of melting of the type originally proposed by Lindemann. The theory also appears to lead to a critical temperature for melting, but further work to render the theory reliable at high pressures is needed before this can be substantiated. R. W. P.

2950. Dissociation Treatment of Condensing Systems. W. Band. *J. Chem. Phys.* 7. *pp.* 324–325, *May*, 1939.—Fowler pointed out that imperfect gas theory can be treated as a problem in dissociation, and it is now shown that Mayer's general results based on the use of the most probable type of clustering dependent upon temperature [see Abstract 1520 (1937)] can be derived almost immediately from the theory of dissociating assemblies, thus avoiding much of his preliminary argument. The dissociation treatment, moreover, leads to a much more tractable method of attacking actual cares, *e.g.*, saturated vapour-equations, than that used by Mayer and Àckermann [see Abstract 521 (1937)], the essential advantage being that the computational difficulties are resolved into two separate problems, *viz.*, (*a*) to obtain from the properties of saturated vapour, information on surface energies of clusters of vapour molecules; (*b*) to use data (*a*) in a study of molecular force fields. A rough check on the properties of water vapour has shown the orders of magnitude to be correct. H. H. Ho.

2951. Zero-Point Energy and Lattice Distances. J. Corner. *Faraday Soc., Trans.* 35. *pp.* 711–716, *June*, 1939.—It is shown that the expansion of a crystal lattice by the zero-point energy must be taken into account in any attempt to choose intermolecular potentials by comparison with crystal data. Taking this correction into account, approximate potentials for Kr, Xe, CO, and CH_4 are derived from their critical temperatures and molar volumes extrapolated to 0°K. AUTHOR.

2952. Analogues of Entropy. T. H. Hazlehurst. *J. Phys. Chem.* 43. *pp.* 759–765, *June*, 1939.—It is shown that entropy and temperature are not unique but have properties analogous to other extensive and intensive energy factors, respectively. In particular, it is shown that the entropy is not the only function that may tend to an extreme value for the universe because of irreversibility. AUTHOR.

2953. Specific Thermodynamic Properties of Dilute Ionic Solutions. J. Kielland. *J. Phys. Chem.* 43. *pp.* 797–803, *June*, 1939. —Simple equations (of the Debye-Hückel-Brönsted-Guggenheim type) and parameters with numerical tables are given for some 100 electrolytes at 0° and 25° C., by means of which osmotic and activity coefficients may be computed for solutions of single as well as of mixed electrolytes. The most accurate and useful concentration range is up to ionic strengths of about 0·1 molal. AUTHOR.

See also Abstracts 2666, 2732, 2935, 2943.

VAPORISATION AND CONDENSATION.

***2954. Efficiency of Rotary Distillation Column. B. J. Mair and C. B. Willingham.** *Bureau of Standards, J. of Research,* 22. *pp.* 519–527, *May*, 1939.—Determinations of the height equivalent to a theoretical plate (H.E.T.P.), hold-up, and through-put were made on a rotary distillation column of the Pegram-Urey-Huffman type having a rectifying section 56 cm. long and 5·08 cm. in dia. Using as rotating members (1) baskets with fine holes, (2) flat plates, and (3) cones, tests of separating efficiency were made at speeds of rotation ranging from 250 to 1500 r.p.m. and through-puts ranging from 1 to 10 ml. of liquid per min. The binary system methylcyclohexane-*n*-heptane was used as the test mixture. The lowest H.E.T.P. was obtained with the conical rotating members spaced 0·64 cm. apart, with which the following average results were obtained : H.E.T.P., 1·04 cm. ; hold-up, 1·3 to 1·6 ml. of liquid per theoretical plate ; maximum through-put, 10 ml. of liquid per min. Within the reproducibility of these experiments, there was no variation in H.E.T.P. for values of through-put from 2 to 10 ml. of liquid per min. and speeds of rotation from 250 to 1500 r.p.m. AUTHORS.

2955. Behaviour of Rubber Hydrocarbon in a Molecular Still. W. H. Smith and H. J. Wing. *Bureau of Standards, J. of Research,* 22. *pp.* 529–533, *May*, 1939.—The values of the molecular weight of rubber reported in the literature vary from 600 to 350,000 and higher. If the vapour pressure were sufficiently increased, and maintained below the decomposition point of rubber, it seemed possible that the molecules, if small, might distil. To determine this, three distillations were attempted at 160° C. for different periods, and with different temperatures at the condensing surface. In one experiment, which was conducted for about 100 hr., the condensing surface was chilled by liquid air. A thin transparent deposit consisting of about 2 mg., appeared on the condensing surface. It was feebly extensible and did not recover completely when deformed. Its physical properties more nearly resembled rubber than those of other distillates. In a second experiment lasting 250 hr. solid CO_2 and acetone were used in the condenser, and in a third one, which was continuous during 140 days, the condensing medium was tap water at about 10° C. It was difficult to remove oxygen from the specimens of rubber which were used. Consequently, the distillates in these experiments were oxidised, at least in part. The distillation products, one of which amounted to about 20 mg., were hard, transparent, and insoluble in ordinary solvents of rubber. In the third experiment the distillate amounted to about 20 mg.

and showed an iodine number of 328 as compared with 370 for the original purified rubber, indicating that oxidation or cyclisation or both may have taken place. AUTHORS.

See also Abstracts 2675, 2808.

ACOUSTICS.

***2956. Construction, Performance and Design of Air-Jet Acoustic Generator. J. Hartmann.** *Journ. Sci. Instruments*, 16. *pp.* 140–149, *May*, 1939.—Describes the progress made in the development of the sound generator [see Abstract 1823 (1927)]. The waves emitted are characterised by high frequency and great intensity. At an excess pressure of $3\cdot 2$ kg./cm^2., the acoustic output is 6 W at a frequency of 50000, and about 150 W at 10000 with an efficiency of 4%. Details of construction are given for some of the types developed. The performance of the generator is described under variation of wave-length with distance a of nozzle from aperture of oscillator; variation of intensity with distance a, in an equatorial plane. The intensity rises rapidly from the region of instability, is nearly constant for a certain distance, and finally decreases somewhat rapidly. The variation of the coefficient of attenuation with the wave-length is graphed, and is considerably in excess of the theoretical value. Information is now available for the design of a generator which will operate with maximum economy. G. E. A.

2957. Periodic Variation of Temperature Caused by Sound Waves. T. Hayashi. *E.T.J.* 3. *pp.* 103–106, *May*, 1939.—Two experimental arrangements are described, one for the purpose of indicating the temperature variations due to the adiabatic changes in sound waves sent along a tube by a loud-speaker. The equipment contains a 12-couple thermopile, the output of which is passed through amplifiers, attenuator and band-pass filter to a valve voltmeter. In the second set a hot wire is situated in a tube in which a stationary wave is set up, and a thermocouple in contact with the hot wire registers the temperature changes which occur at the antinode of the stationary wave. The amplifying and other equipment is similar to that used in the first experiment. G. E. A.

2958. Supersonic Velocity and Adiabatic Compressibility of Liquids. S. Bhagavantam and C. V. J. Rao. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 312–315, *April*, 1939.—The supersonic velocity has been measured in C_6H_6, CCl_4, CS_2, cyclohexanol, acetic anhydride and glycerin and hence the adiabatic compressibility calculated. The latter has also been measured directly with a piezometer and good agreement is found to exist between the values obtained in the two methods for all the six liquids. No dispersion of the supersonic velocity has been found in carbon tetrachloride in the range 1 to 13 megacycles. The dependence of the supersonic velocity on temperature has been investigated in cyclohexanol and glycerin in the range 30° C. to 80° C. AUTHORS.

2959. Dispersion of Supersonic Velocity in Liquids. K. G. Krishnan. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 382–385, *May*, 1939.—Three ranges of frequencies from about $1\cdot 5$ to 7 Mc./sec. were employed in five liquids: xylol, benzene, CCl_4, CS_2 and water. In the case of distilled water an additional frequency 22·5 Mc./sec. was also used. It is concluded from the data obtained for these liquids that within the limits of experimental error there is no definite evidence of acoustic dispersion over the frequency range employed. AUTHOR.

2960. Difffraction of Light by Supersonic Waves. Part I. K. N. Rao. *Indian Acad. Sci., Proc.* 9*A. pp.* 422–446, *May*, 1939.—The three methods (series, Bessel-function and closed expression) which have been used for dealing with the problem of the diffraction of light by supersonic waves have been worked out in detail and the amplitude expressions for the diffracted orders are written *in extenso*. In the case of the third method, the intensity expressions assume a simple form. AUTHOR.

2961. Fresnel Diffraction Effects with Supersonic Waves and Evaluation by Mascart's Method. F. Mahler. *Ann. d. Physik*, 34. 8. *pp.* 689–716, *April*, 1939.—The Fraunhofer diffraction effects in supersonic waves have been well investigated experimentally, and Raman and Nath's theory is in complete agreement with the observations. A calculation of the Fresnel diffraction images based on Raman's theory leads to difficult integrations, and Mascart's method of approximation has been applied to the present investigation. Its utility has been proved by a comparison with Raman's calculations for Fraunhofer diffraction which agree with the author's measurements. The hitherto unknown small change Δn of the refractive index within the sound field can now be calculated. There is thus established a relationship between the Mascart method and the Töpler *Schlieren* method with which it is possible to measure the change Δn directly. The comparison with the results of theory also brought out that the mass number of Raman and Nath for the sound intensity is equal to the number of orders involved, and this again is directly proportional to the pressure in the sound wave. It was also found that the surfaces of structureless brightness behind the sound field are produced by the overlaying of the intensity distributions of all the phases of the sound waves. From the calculated curves it is concluded that the " washed-out " places, which are still present when stroboscopic illumination is used, may be caused by the change of the wave surface during the period of illumination of the Kerr cell. G. E. A.

2962. Influence of Supersonic Vibrations on Rotatory Power of High-Molecular Substances. Part I. Gelatin Solutions. N. Sata. *Kolloid Zeits.* 87. *pp.* 186–190, *May*, 1939.—It has been established that the supersonic vibration effect first causes a spontaneous strong decrease of the rotation, which, however, recovers on standing, and also that a general lowering of the mutarotation curve is produced. The first reversible effect is attributed to a dehydration or destruction of the hydrate envelope, whereas the irreversible decrease of mutarotation is ascribed to a chemical change such as depolymerisation. The influence of long exposure shows that the mutarotation curve falls quickly, and that the solution becomes inactive after 10–12 days' working of the effect. It is established that the turbidity and colour which appear during exposure to supersonic vibrations are intimately connected with the mechanism of the effect. H. H. Ho.

***2963. Synthetic Speaker. H. Dudley, R. R. Riesz and S. S. A. Watkins.** *Frank. Inst., J.* 227. *pp.* 739–764, *June*, 1939.—This synthetic speaker is an electrical device manipulated by keys and levers for the production of synthetic vocal sounds and their combination into speech.

The device was developed as an interesting educational exhibit by the Bell System at the San Francisco Exposition and the New York World's Fair. From a buzzer-like tone and a hissing noise as raw material, the operator skilfully shapes speech by manipulating the controls to give inflection and the sound spectrum that differentiates one speech sound from another. This paper covers the development of the device and the training of the operators to demonstrate it. AUTHOR.

2964. Analysis of Musical Sounds. A. Dammann. *Comptes Rendus*, 208. *pp.* 1283–1285, *April* 24, 1939.—Records are shown of the wave forms of notes of the trombone, trumpet, flute, clarinet and violin, obtained by means of the kathode-ray oscillograph. The notes, of different pitch and intensity, were analysed by a Coradi harmonic analyser as far as the 50th harmonic. The results are given in series of sound spectra for the different instruments. Among the conclusions the following are stated : The clarinet alone gives a fundamental of considerable intensity. In the trombone and trumpet the important harmonics form a single group, in the clarinet and violin they are isolated, in the flute they are grouped round one or two preponderant harmonics. When the frequency of the fundamental is increased, the maximum of a group is displaced in the direction of the lower harmonics in the trombone and trumpet. In the clarinet the order of the dominant harmonic does not depend on the fundamental frequency. With constant frequency and increased intensity the maximum is displaced towards the higher harmonics in all cases. G. E. A.

2965. International Standard of Concert Pitch. G. W. C. Kaye. *Nature*, 143. *pp.* 905–906, *May* 27, 1939.—An international conference on the above question was held on May 11–12 last at Broadcasting House [see Abstract 369 (1939)]. Five countries, besides other interested bodies, sent delegates to the conference. In the reports submitted by different countries there was almost complete agreement on the choice of A440 as the standard of pitch. The conference unanimously agreed to send the following recommendations to the parent International Acoustics Committee and the other Associations concerned, with a view to their ratification : (1) That the international standard of concert pitch shall be based on a frequency of 440 $\sim$ for the note A in the treble clef ; (2) that this value shall be maintained within the closest limits possible by soloists, orchestras, choirs, etc., throughout all musical performances, and also in recorded music ; (3) that with a view to reducing the necessary tolerances to acceptable values, a set of technical recommendations be drawn up, preferably on the basis of international cooperation. An appendix to the recommendations deals with a number of practical points. G. E. A.

2966. Absorption of Sound in CO_2 and Mixtures. A. van Itterbeek, P. de Bruyn and P. Mariëns. *Physica*, 6. *pp.* 511–518, *June*, 1939. *In English.*—Measurements were made on the absorption of sound in highly purified CO_2 gas up to 50° C. From these measurements the relaxation time and the number of efficient collisions for the excitation of the vibrational energy of the CO_2 molecule were calculated. Measurements were also made on CO_2 to which had been added small amounts of H_2, D_2, H_2O and D_2O. From these measurements, the difference between the excitation of the vibrational energy by these various molecules could be determined. If O_2 is added to CO_2, the absorption coefficient decreases. The absorption was studied in mixtures of CO_2 and O_2. The experimental curve can be interpreted as pointing to the fact that the CO_2 molecules are not excited at all by the O_2. AUTHORS.

See also Abstract 3061, and

1604B. Ohm's Acoustic Law. F. Trendelenburg.
1735B. Magnetostriction Oscillator. W. W. Salisbury and C. W. Porter.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 2982.

CONDUCTION AND DISCHARGE IN GASES.

2967. Sparking Potential in Hydrocarbon Vapours. Part I. Benzene. E. Badareu and L. Constantinescu. *Soc. Roumaine de Physique, Bull.* 39. 72. *pp.* 45–72, 1938. *In French.*—The sparking curve $V = f(p.d)$ is established in benzene vapour between parallel electrodes. The apparatus and arrangements that are necessary for reproducible results are described in details. Paschen's law is exactly confirmed. The minimum sparking potential V_{min} is 489 ± 1 V for an Al kathode and 498 ± 1 V for a Cu kathode; the critical value $p.d_{min}$ is in both cases 0·24 ± 0·01 mm. Hg. cm. A rather high energy transfer seems to be necessary for the formation of an ion pair by electron collision in benzene vapour. This could be explained by the very many different ways in which energy absorption by the benzene molecule may occur. The number of ions per cm. path at energy optimum is nevertheless bigger than in other gases. Adsorption phenomena on the kathode alter the sparking potential. AUTHORS.

2968. Spark-Gap Discharges. A. de Stefano and B. Ferretti. *N. Cimento,* 16. *pp.* 20–33, *Jan.,* 1939.—The authors show that the times through which a spark-gap discharge lasts, can assume constant values of the order of 10^{-8} sec. if rectangular wave-fronts are used and if the electric field is of sufficient intensity. An electro-optic method based on the Kerr-effect is described for measuring the time of discharge. The electric field of the discharge has been measured with a similar arrangement. L. K.

2969. Development of Electron Surges in Spark Tracks. H. Raether. *Zeits. f. Physik,* 112. 7–8. *pp.* 464–489, 1939.—The previously reported expansion chamber investigation of the development of electron surges in gas discharges [see Abstract 5059 (1937)] is extended beyond the stage of exponential increase of ionisation to the sparking (impulsive breakdown) stage. For impulsive voltages a little in excess (10 to 20%) of the static breakdown voltage and with large electrode spacing (3·6 cm.) in air at high pressure (300 torr.) it is established that the spark track can be produced by a single electron surge. This is explained on the basis of the inset of instability of the surge above a critical amplification and the propagation with high velocity (~ 10^8 cm./sec.) from the head of the surge of narrow ionisation tracks first to the anode and then back to the kathode so that a "pre-discharge track" bridges the electrodes; this track which at first is weak in current and light intensity rapidly increases in both intensities into the spark. J. E. K.

2970. Change of Sparking Potential by Irradiation of Molecular Gases. W. Fucks and G. Schumacher. *Zeits. f. Physik*, 112. 9–10. *pp.* 605–613, 1939.—Measurements are made of the change in the sparking potential, U, between plane electrodes in N_2 due to irradiation of the kathode with u.v. light. The Rogowski-Fucks law $\Delta U/U = ki^{1/2}$ (i = photo-current, k = constant) is confirmed by the measurements. Experimental determination of k allows a test of the theory on which the law is based. It is found that under the conditions of the experiments 30 to 40% of the decrease of sparking potential by irradiation can be attributed, as assumed in theory, to the change of field strength by space charge of the photo-current and the corresponding change of positive ionisation at the kathode. J. E. K.

2971. Reignition of Short Arcs at High Pressures. J. D. Cobine, R. B. Power and L. P. Winsor. *J. of Applied Physics*, 10. *pp.* 420–424, *June*, 1939.—An investigation has been made of the reignition of short a.c. arcs in air at pressures from 1 to 8 atm., for currents less than 3·25 A (and with a resistance circuit). Pure graphite electrodes were used and were separated by a distance of 1 mm. The reignition voltage under these conditions increases with pressure and decreases as the current is increased. The characteristic of reignition potential *vs.* current has been found to exhibit a discontinuity at a critical current. For this current the reignition potential decreases by about 1000 V to a new characteristic typical of the higher currents. This critical current increases with the gas pressure to a maximum of 2·25 A. As the r.m.s. current is increased from low values to values near the critical, the number of cycles during which the reignition potential has the value given by the higher characteristic decreases. For currents equal to, or greater than the critical value, only the low reignition potentials are obtained. This transition is accompanied by an increase in the burning voltage of the arc. AUTHORS.

2972. Luminous Zones near Glow-Discharge Kathodes. H. Sporn. *Zeits. f. Physik*, 112. 5–6. *pp.* 278–304, 1939.—The investigation concerns the origin of the very thin luminous zones immediately in front of the kathode of a glow-discharge tube which were previously noticed in the discharge by Güntherschulze and Keller [see Abstract 2975 (1932)] when using various kathode materials. Experiments are made with discharges in He, A and O_2 and with massive kathodes coated with Li, Na, Mg and their oxides to various thicknesses. The luminous zone exhibits the spectrum of the metal with which the kathode is coated; it disappears with increasing thickness of coating and is most intense for the oxide coatings. The intensity in the zone decreases exponentially from the kathode surface outwards into the gas. The observations are satisfactorily explained as due to the liberation from the kathode coating by sputtering of ions which are able to attract electrons from the kathode surface and so to form excited atoms. The thickness of the zone is thus a function of the mean life period of the atoms in the excited state and the velocity of the excited atoms. J. E. K.

2973. Electron-Collision Excitation Functions of Metals with High Boiling Points. H. Fuhrmann. *Ann. d. Physik*, 34. 7. *pp.* 625–643, *April*, 1939.—It appeared to be of interest to examine the excitation of an element whose lowest term from which the excitation starts is a triplet. On technical grounds only Pb comes into consideration. In contrast with the easily vaporised metals whose highest temperature needed was 540° C. there occur with metals possessing high boiling points greater experimental difficulties, the observing of which was the object of the research described. With two newly constructed electron tubes the excitation function of three metals with high boiling points was measured. Tl as typical of the third division of the periodic system of the elements was investigated by two different methods. The green Tl line so unique in the visible spectrum was measured by visual means by comparison with the Tl spectral lines. The excitation function of five other lines was obtained photographically and some earlier values obtained by Strohmeier were improved upon. Then six lines of the visible Ag spectrum as representative of the first division of the regular elements were excited and there were found equally legitimate results as well as similar form of the E.F. as found with Tl and Na: (1) Lines from the same upper terms have similar E.F. of the same lines of a series, since they proceed from similar upper terms; (2) within a series the maximum of the E.F. shifts with increasing member number by an amount proportional to the shifting of the E.F. Finally the course of the E.F. was determined for 13 Pb lines and examination was especially made regarding the difference between singlet and triplet excitation as it is known in the second division of the periodic system (Cd, Zn and Hg). These have as ground terms a singlet term; Pb on the contrary has a triplet term. J. J. S.

2974. Effect of Admixtures of Electronegative Gases on the Current-Potential Diagram of Ionised Nitrogen. R. Grossmann. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 7–8. *pp*. 349–364, 1938.—It is known that the negative ions in pure N_2 and in the rare gases are free electrons. The current-potential characteristics of these gases are consequently distinguished by the fact that even for relatively low potentials they exhibit a rapid convergence towards a definite saturation value. The addition of quite small quantities of other gases, such as O_2, CO and CO_2, affects by the formation of molecular ions the high mobility of the negative electricity carriers. An investigation was made of the dependence of the current-potential diagram on the nature and quantity of the foreign gas. From the results obtained a practical method was evolved for determining both qualitatively and quantitatively the amount of O_2, CO and CO_2 present in N_2, from measurement of the ionisation current strength and from the shape of the rise of the characteristic. A. W.

2975. Townsend Coefficients for Ionisation by Collision in Pure and Contaminated Hydrogen as a Function of the Kathode Material. D. H. Hale. *Phys. Rev.* 55. *pp*. 815–819, *May* 1, 1939.—Using kathodes of Pt and Na and NaH-coated Pt, the Townsend coefficients were measured for pure Hg-free H_2 and for H_2 contaminated with Na and NaH vapour. Values of α/p are, in general smaller for pure H_2 than for H_2 contaminated with Hg vapour, Na, or NaH. Curves for α/p, β/α, and γ, as a function of X/p are given and the significance of peaks is discussed. The peaks indicate relatively large photoemission effects at the kathodes at the lower values of X/p and in the case of the Pt kathodes at higher values of X/p the curves show a general rise caused by electron emission due to the bombardment of the kathode by positive ions. The values of β/α and γ for the Na surfaces are much smaller than in the case of Pt for the higher values of X/p indicating that these surfaces are relatively poor emitters under positive ion bombardment. Sparking potentials measured at each value of X/p give curves in approximate agreement with curves obtained from values calculated from the γ-coefficients. N. M. B.

2976. Ionisation Coefficients α and γ. A. Gosseries. *Physica,* **6.** *pp.* 458–472, *May,* 1939. *In French.*—The theoretical part of the paper consists of a comparatively simple transformation of the Townsend ionisation formula, resulting in an exponential relationship which is readily amenable to experimental verification. It is shown that the formula may be used for the direct determination of the ionisation coefficients α and γ. For the measurement of the current flowing in a gas, a direct method of compensation of variations of the u.v. irradiation of the kathode is described. This consists of balancing the discharge current against the current from a photo-cell irradiated by the same lamp as the kathode. Particular attention is paid to the elimination of both random and systematic errors. The simplicity of the experimental method and of the application of the formula is demonstrated by a series of determinations of α and γ in pure H_2. J. E. R.

2977. Electron Transfer in Argon. F. L. Arnot and W. D. Hart. *Roy. Soc., Proc.* 171*A. pp.* 383–397, *June* 6, 1939.—An investigation of the electron transfer process $A^{2+} + A \rightarrow A^+ + A^+$, has been made by a new method using incident A^{2+} ions having energies from 162 to 404 eV. For each of these energies the forward moving A^+ ion has an energy, due to its velocity component in the direction of the incident A^{2+} ion, of 13 eV less than that of the A^{2+} ion. It is shown that the angle between the direction of the forward moving A^+ ion and that of the incident A^{2+} ion is about 15·2, 10·6 and 7·4° respectively for energies of the A^{2+} ion of 100, 200 and 400 eV. These angles of scattering are considerably greater than those for the corresponding process in Hg which are less than 5, 3·6 and 2·5° respectively for Hg^{2+} ions of energy 100, 200 and 400 eV. The cross-section for the process over the energy range of 162 to 404 eV has been obtained, and this shows a linear increase of cross-section with energy of the incident A^{2+} ion, the value of 404 eV A^{2+} ions being about one-hundredth of the gas-kinetic cross-section for collision. Extrapolation of the cross-section curve gives the activation energy as 76 eV. Attention is drawn to a numerical error made in determining the cross-section of the corresponding electron transfer process in Hg, previously reported [see Abstract 1336 (1939)]. The ordinates of this curve should all be multiplied by a factor of 2. With this correction, the value of the cross-section for the Hg process is greater than one-tenth of the gas-kinetic cross-section over the entire energy-range used, 140 to 400 eV. AUTHORS.

See also Abstracts 2820, 2831, 2833, 2834, 2840, 2862, 3007.

CONDUCTION IN SOLIDS AND LIQUIDS.

2978. Equilibrium Theory of Ionic Conductance. M. H. Gorin. *J. Chem. Phys.* 7. *pp.* 405–414, *June,* 1939.—A theory for ionic conductance which assumes that the equilibrium between the central ion and its ionic atmosphere is not appreciably distorted by the application of the external field is proposed. On the basis of this approach, values of the radii for the individual ion are obtained by the extrapolation of conductance and transference data to infinite dilution. These values of the radii when inserted into the equations resulting from the theory yield expressions for conductance and transference that very closely follow the experimental ones up to 0·02 *M.* Even at concentrations as high as molar, the discrepancy between the equilibrium theory and experiment is not large. The values of the ionic radii obtained from the theory are also correlated with the corresponding values of equivalent conductances at infinite dilution. The larger the ion, the more closely does it appear to obey the laws of classical hydrodynamics. For smaller ions, deviations from classical hydrodynamics increase rapidly as the radius decreases. On this basis, the high conductance of hydronium ion appears to follow naturally from the small radius obtained, namely, 0·95 Å. Furthermore, the deviation from the classical theory appears to be given by an expression involving the size of the hole that the ion must make in order to jump from equilibrium position to equilibrium position in the solvent, an idea suggested by the modern theory of liquids as developed by Eyring and his collaborator. AUTHOR.

2979. Theory of Electronic Semiconductors. B. R. A. Nijboer. *Phys. Soc., Proc.* 51. *pp.* 575–584, *July,* 1939.—A discussion of the discrepancies between Wilson's theory of semiconductivity and recent experiments on the subject is given; and on the basis of Wagner and Schottky's theory of *Fehlordnung* [see Abstract 1716 (1931)], an extension of Wilson's theory, which may remove the discrepancies in some cases, is proposed. AUTHOR.

***2980. Apparatus for Measuring Very Intense D.C. R. Fortrat.** *J. de Physique et le Radium,* 10. *pp.* 190–194, *April,* 1939.—A method is suggested for measuring a current of up to 50000 A by passing it through a hollow cylindrical conductor and measuring the field strength at the centre of the cylinder by means of a suspended magnetised needle attached to a control spring. The relation between field strength at the centre and the current may be calculated. A typical arrangement is described in detail; it has 3 ranges of approximately 0–5000, 5000–13500 and 9000–21600 A respectively. H. J. H. S.

2981. Absolute Determination of the Ampere, Using Improved Coils. H. L. Curtis, R. W. Curtis and C. L. Critchfield. *Bureau of Standards, J. of Research,* 22. *pp.* 485–517, *May,* 1939.—The absolute value of a current has been measured by the current balance, using improved coils. The previous work had shown that improvements in the coils were required in order to make them fulfil more nearly the conditions assumed in developing the equations for computing the absolute value of a current from the force measured by the current balance. These new coils consisted of one moving coil made in the form of a short solenoid and one moving coil and one pair of fixed coils wound from anodised Al ribbon in the form of a flat spiral. The results obtained with various combinations of these new coils and one pair of the old fixed coils are consistent among themselves, and their weighted average can be expressed as 1 NBS international ampere = 0·999 86 absolute ampere. This result differs appreciably from that obtained in the preceding work [see Abstract 2995 (1934)], but it is felt that this new value is more reliable because of the improved coils which were used and the greater consistency of the results. AUTHORS.

***2982. Gold-Chromium Resistance Wire. T. B. Godfrey.** *Bureau of Standards, J. of Research,* 22. *pp.* 565–571, *May,* 1939.—By heat treatment, the temperature coefficient of electrical resistance of Au-Cr coils containing 2·1% of Cr can be made extremely small within the interval 18° to 35° C., and the resistance of such coils is extremely stable. Consequently, a resistance bridge made with Au-Cr coils and without temperature control should be fully as good as the customary bridge with manganin coils and thermostatic control. Data obtained during the construction and testing of four 10-ohm coils are given. [See Abstract 5199 (1934).] AUTHOR.

***2983 Resistance Material "Novokonstant." A. Schulze.** *Phys. Zeits.* 40. *pp.* 357–360, *May* 15, 1939. *From the Reichsanstalt.*—A Cu-Mn alloy containing Al and Fe, and called "Novokonstant" was investigated for use in electrical resistance standards. The resistance-temperature curve is very similar to that of manganin and has an S-shape, which is typical of all Cu-Mn alloys. At room-temperatures the thermal coefficient of resistance is very dependent on heat treatment and can be reduced to only a few parts in a million per ° C. by heat treatment at 400° C. The thermo-e.m.f. of Cu-novokonstant junctions is measured and found to be less than 1 μV/° C. at room-temperature. The variation of the mechanical properties with heat treatment, and the secular change of resistance were also investigated. It is concluded that Novokonstant appears to be very suitable for resistance standards. S. W.

2984. Distribution of Electrochemical Potentials in the Cu_2O Rectifier. E. Lange. *Phys. Zeits.* 40. *pp.* 230–232, *April* 1, 1939.—In describing the phenomena occurring in a rectifying layer, it is convenient to introduce the electrochemical potentials for the different types of ions present, and to plot their variation across the surface layer. R. P.

2985. Relaxation Connected with Transition from Supra-Conductive into Normal State. P. H. van Laer and H. J. Groenewold. *K. Onnes Lab. Leiden, Comm. Suppl. No.* 86*b. Physica,* 6. *pp.* 473–480, *June,* 1939. *In English.*—In this paper the time effects occurring in magnetic phenomena connected with the transition from the supraconductive to the normal state are compared with the relaxation observed in calorimetric experiments and the conclusion is drawn that there must be an essential difference between them. Further it is concluded that there must also be an essential difference between the transition effected by heating and that caused by increasing the external field. Starting from a simple assumption it appears to be possible to derive some formulæ which are in agreement with the experimental results. AUTHORS.

2986. Thermodynamical Properties of Some Supraconductors. J. G. Daunt, A. Horseman and K. Mendelssohn. *Phil. Mag.* 27. *pp.* 754–764, *June,* 1939.—The equilibrium curves of Tl and In have been determined between 1° K. and the transition point, and previous determinations on Sn and Pb have been supplemented by new values. The differences in entropy and specific heat between the supraconductive and the normal state and the specific heat of the system of supraconductive electrons have been evaluated for all four metals. In the case of Sn it could be shown that the values of the specific heat derived from the equilibrium curve agree very well with those obtained by direct calorimetric measurements. It was concluded that at absolute zero *all* free electrons are in the supraconductive state, and that the specific heat of the system of supraconductive electrons might be interpreted as indicating a decrease of the number of supraconductive electrons with temperature. AUTHORS.

See also Abstracts 2673, 2927, 2940, 2983, 3058.

DIELECTRICS AND CAPACITANCE.

2987. Edge Correction in Determination of Dielectric Constant. A. H. Scott and H. L. Curtis. *Bureau of Standards, J. of Research,* 22. *pp.* 747–775, *June,* 1939.—An edge correction is often required in determining the dielectric constant of an insulating material by the capacitance method. Theoretical formulæ by which the edge correction may be computed have been considered for a number of electrode arrangements. Some of these apply to circular electrodes and some to rectangular electrodes. The error in the dielectric constant which may arise from the use of these formulæ is discussed for each of the different arrangements. The accuracies of the methods were experimentally determined by making measurements on the same specimens with the various arrangements of electrodes. The guard-ring arrangement was assumed to give the correct value of the dielectric constant, and the values obtained with the other arrangements were compared with it to determine their errors. Only two methods gave values which were in error by less than 1%. Both methods were for arrangements of electrodes in which one electrode was smaller than the other, one being for circular electrodes, the other for rectangular electrodes. Empirical equations were set up which gave values of the dielectric constant which were in error by less than 1% for all electrode arrangements, both for circular and rectangular electrodes. These equations are much simpler than the theoretical equations. AUTHORS.

2988. Dipole Moments of Anthraquinone Derivatives. E. Fischer and F. Rogowski. *Phys. Zeits.* 40. *pp.* 331–337, *May* 1, 1939.—The dipole moments of dilute solutions of the 1-, 2-, 2 : 3- and 1 : 8-chloroderivatives of anthraquinone are determined. The differences between the observed and the calculated values of the dipole moments are due to the field exerted by the C-Cl group on the molecule. Calculation shows that in the 2 : 3-chloroderivative, the benzene ring to which both Cl atoms are attached, has the same orthoeffect as *o*-dichlorobenzene, although the moments of the two molecules are different. The dipole moment of *p*-xylylene dibromide is found to be $2{\cdot}04 \times 10^{-18}$. [See following Abstract.] E. R.

2989. Effect of Molecular Shape on Dielectric Relaxation Time. A. Budó, E. Fischer and S. Miyamoto. *Phys. Zeits.* 40. *pp.* 337–345, *May* 1, 1939.—The influence of the shape of the molecule and the position of the dipole group on the relaxation time is investigated for dilute solutions of *o*-dichlorobenzene and particularly 1 : 8- and 2 : 3- dichloranthraquinone. The molecules are approximately ellipsoids, but the directions of the moments with respect to the ellipsoid axis are different. The calculations are made by means of Perrin's formula. [See preceding and following Abstracts.] E. R.

2990. Relaxation Times of Molecules with Free Rotating Dipole Groups. E. Fischer and F. C. Frank. *Phys. Zeits.* 40. *pp.* 345–352, *May* 1, 1939.—The influence of the presence of free rotating polar groups on the relaxation time of the molecules is determined. The relaxation times of molecules with free rotating groups (*e.g.*, *p*-xylylene dichloride and dibromide, benzylchloride) are found to be smaller than those of molecules of equal size in which the groups are fixed (*e.g.*, *o*-dichlorobenzene). The results are explained by consideration of two frictional constants, one of which applies for the whole molecule and the other for the rotating group. The values found for the constants are proportional to the sizes of the molecule and the polar group. [See preceding Abstract.] E. R.

2991. Dielectric Study of Gelatin-Water System : Anomalous Dispersion in Bound (Oriented) Water. H. Fricke and L. E. Jacobson. *J. Phys. Chem.* 43. *pp.* 781–796, *June*, 1939.—At frequencies between 0·002 and 65·6 Mc./sec. and for field intensities between 0·5 and 5 V/cm. the dielectric constant and dielectric absorption of gelatin-water systems were determined under different conditions of gelatin concentration, pH, ionic strength, and structural state. The results indicate that the dielectric properties of these systems are dependent on a polarisation at the interphases similar to that already known to be present in more coarsely dispersed systems. It is suggested that this polarisation originates in the interphasial layer of oriented water molecules, and various types of evidence in support of this hypothesis are discussed. The bearing of this on the dielectric behaviour of hygroscopic insulators (paper, fabrics), soil, cell membranes, and metal electrodes is pointed out. AUTHORS.

2992. Dielectric Constants of Ammonium Halides. R. Guillien. *Comptes Rendus*, 208. *pp.* 1561–1563, *May* 15, 1939.—The dielectric constants of the salts NH_4X ($X = F, Cl, Br, I$) have been determined for the solid substances using waves of wave-length 2700 m. The dielectric constant of NH_4F decreased very slowly with falling temperature. There was a slight increase (0·06%) at the transition point. NH_4F also shows only a small specific heat anomaly at the transition point. The most important variations were found with NH_4I. The dielectric constant is a maximum at − 28·5°. The change in crystalline form which occurs at − 5·9° was accompanied by a slight change in dielectric constant. A. J. M.

2993. Dielectric Constants of Ammonium Salts near Lower Transition Temperature. Part I. J. H. Bruce. *Faraday Soc., Trans.* 35. *pp.* 706–711, *June*, 1939.—Measurements are described on the dielectric constants of NH_4Cl and NH_4Br in the powdered form. It is shown that, on cooling through the transition temperatures at − 30·5° and − 38° respectively, the dielectric constants of both salts fall abruptly. AUTHOR.

2994. Nature of Energy Losses in Air Capacitors at Low Frequencies. A. V. Astin. *Bureau of Standards, J. of Research*, 22. *pp.* 673–695, *June*, 1939.—The power factors of a number of types of air capacitors have been observed in the frequency range from 60 to 1000 ~. The method of measurement permitted evaluation of true, or "absolute," power-factor values as small as 5×10^{-7}. In guard-ring air capacitors the losses occur on the surfaces of the electrodes and give rise to a power factor which is proportional to capacitance (inverse electrode separation). The same type of losses in addition to the losses in the solid insulation, are evident in two-electrode capacitors. For most two-electrode air capacitors of variable capacitance, C, the loss may be represented by the function $A + B/C$, where A depends upon the electrode material, humidity, and frequency, and B depends upon the insulation material, humidity, and frequency. Of the 10 metals used as electrode materials in guard-ring capacitors, aluminium gave the greatest power factor and silver plate the smallest. The power factors for the other materials, which included brass, monel metal, stainless steel, nickel, and brass plated with gold, rhodium, and chromium, were only slightly different from that for silver-plated brass, but they were appreciably smaller than the values for aluminium. The power factor of a guard-ring capacitor is a function of humidity and shows a maximum value at relative humidities between 40 and 70% at low frequencies. The maximum value is apparently due to a variable conductivity of the moisture layer with thickness. The loss which occurs in the electrode surface layer is also a function of the homogeneity of the electric field. The non-uniform field in a three-electrode rotating-plate capacitor gives rise to a power factor which decreases as the capacitance is increased. AUTHOR.

***2995. Low-Range Air Condenser. W. H. Ward and E. J. Pratt.** *Journ. Sci. Instruments,* 16. *pp,* 192–195, *June,* 1939.—The variable air condenser described is intended to measure capacitances of a few micro-microfarads to $\pm 0{\cdot}001$ μμF. It is of the micrometer type, and has been so designed as to avoid the commoner causes of instability. Authors.

2996. Influence of Molecular Structure on H.F. Dispersion and Absorption. E. Keutner and G. Potapenko. *Phys. Zeits.* 40. *pp.* 100–104, *Feb.* 1, 1939.—Measurements of absorption and dispersion at wavelengths of 0·18 to 1·3 m. are reported on methyl, ethyl, *n*-propyl and *n*-butyl alcohols. The radius of the rotating polar groups calculated from the measurements is found to be approximately the same for the four alcohols, and it is concluded that the dispersion and absorption effects at these wave-lengths are due to the rotation of the polar OH groups forming part of the molecules, and not to the rotation of the whole molecules. [See following Abstract.] E. R.

2997. Influence of Polar OH Groups in Alcohols. K. L. Wolf. *Zeits. f. phys. Chem.* 43. *Abt.B.* 1. *pp.* 20–24, 1939.—Recent work on alcohols is reviewed, in which values for the mobility and radius of the polar OH groups are calculated from measurements of h.f. absorption and dispersion. It is pointed out that the results of Keutner and Potapenko [see preceding Abstract] are open to doubt, since factors such as the influence of the polar CO groups and the interaction between the polar molecules have not been taken into account. E. R.

2998. New Electrical Phenomenon. G. Piccardi. *Accad. Lincei, Atti,* 29. *pp.* 84–85, *Jan.–Feb.,* 1939.—A Leyden jar with removable inner cover is charged; after a few minutes the inner cover is removed and the jar (glass or ebonite) filled with water. Then after another few minutes the water will be in the R-state previously described by the author as one of two new modifications of polar liquids [see Abstract 3822 (1938)]. It is hoped that this method will facilitate a thorough investigation of the new phenomena. L. E. F.

See also Abstract 2669.

ELECTROCHEMISTRY.

2999. Theory of Daniell Cell. E. Toporesco. *Soc. Roumaine de Physique, Bull.* 39. 72. *pp.* 95–100, 1939. *In French.*—The author investigates the mode of production of the e.m.f., deriving the formula $nE = RT [\log P_1/p_1 - \log P_2/p_2]$ from Nernst's theory. The *p*H values for cells with a Hg electrode 4·5 cm. in dia. after short circuiting for 3 hr. are respectively—for HCl 1·9, for HCl and Hg 1·9, for the HCl of the cell 2·6; the author concludes that in short circuit the process is primarily electrolysis, secondarily the Zn deposited on the anode displaces Cu from the $CuSO_4$ solution. D. R. H.

3000. Ag-Pt Contacts in Aqueous Iodides. S. Veil. *Comptes Rendus,* 208. *pp.* 1306–1307, *April* 24, 1939.—The e.m.f. of the cell Ag | KI_{aq} | Pt [see Abstract 1356 (1939)] is found to be 0·10, 0·57, 0·74 V when saturated with HgI_2, AgI, PbI_2 respectively, against 0·73 V for the original salt. With PbI_2 there is the possibility of some process analogous to an order $\rightleftarrows$ disorder transformation, with HgI_2 combination may occur, AgI seems to occupy an intermediate position. D. R. H.

3001. Electrolysis of Molten Salts. P. Drossbach. *Zeits. f. Elektrochem.* 45. *pp.* 435–440, *June,* 1939.—From a consideration of the progress of electrolysis in mixtures of $ZnCl_2$, $PbCl_2$, NaCl, $SnCl_2$, the author concludes that there are no fundamental differences between the mechanism and that of electrolysis in aqueous solution. For separation of two metals, the following points should be observed: (1) ease of complex formation of one metal; (2) careful control of polarisation voltage, which should be identical with the work at limited electrode potential in rapid electrolysis. D. R. H.

3002. Mechanism of " Oil Potentials." G. C. H. Ehrensvärd and L. G. Sillén. *Zeits. f. Elektrochem.* 45. *pp.* 440–456, *June*, 1939.—The authors discuss critically the mechanism of the "oil potential" set up in cells with an oil-water emulsion between two aqueous electrolytes. Of the two theories proposed, partition equilibrium at the phase boundaries (VD theory), and adsorption equilibrium, the data are satisfactorily explained by the second, while the first is found to be untenable. From a generalised formula for partition potential the diffusion potential is calculated for the case where the electrolytes do not completely penetrate the oil film. A general adsorption isotherm corrected for activity gives the observed experimental values. Potentials with ion adsorption at a double layer are derived, and the case of adsorption of widely separated ions is discussed. Possible physiological importance is indicated, and a Bibliography of 50 references is appended. D. R. H.

3003. Scientific Bases of Polarographic Analysis. M. v. Stackelberg. *Zeits. f. Elektrochem.* 45. *pp.* 466–491, *June*, 1939.—A critical review. An exhaustive Bibliography of 87 references, mostly Czech, is appended. D. R. H.

See also Abstract 2698.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3004. Equations of the Mesotron. P. Caldirola. *N. Cimento*, 16. *pp.* 14–19, *Jan.*, 1939.—The author gives a modification of his gravitational equations [see Abstract 2357 (1939)] which enables him to include the mesotron in his theory. His former equations were only applicable to a particle of spin zero. In the case of spin one (mesotron), Riemann's tensor R_i^j becomes: $R_i^j = F_{ik}F^{jk} + \chi_{ik}\chi^{jk} + \lambda^2\Phi_i\Phi^j$, where F_{ik} is a semi-symmetric tensor and χ_{ik} an unambiguous function of ϕ. The equations of the electromagnetic field are satisfied if: $\chi_{ij} = \Phi_{ji} - \Phi_{ij}$; $\chi_k{}^{kj} = \lambda^2\Phi^j$ and $\chi_{ikj} + \chi_{kji} + \chi_{jik} = 0$. These three relations are the generalisations of Proca's equations. F_{ik} is the rotor of the vector potential A_i of the electromagnetic field which determines the emission of protons while Φ_i is the potential of the nuclear force field and determines the emission of mesotrons. L. K.

3005. Internal Motion of the Electron. Part I. H. Hönl and A. Papapetrou. *Zeits. f. Physik*, 112. 9–10. *pp.* 512–540, 1939.—Lubański's approximate solution of the field equations of gravitation [see Abstract 2723 (1938)] is applied to a dynamic system of vanishing dimensions in space consisting of a mass pole and a mass dipole superimposed. It results that the motion of the particle can be split up into two components, one of them with zero momentum but finite angular momentum, called the internal motion, the other, corresponding to the motion of ordinary particles, called macroscopic motion. The Hamilton function of this particle has a close resemblance to the Hamilton operator of a Dirac electron. In the special case when the internal velocity of the particle reaches the velocity of light, the model reduces to a point of infinite mass but finite rest energy revolving on a circle, analogous to a simpler electron model previously proposed by Hönl [see Abstract 827 (1939)]. In an electric field the particle, if carrying the charge *e*, behaves like a classical electron. L. E. F.

3006. Fundamental Length Connected with Elementary Particles. A. Proca. *Comptes Rendus*, 208. *pp*. 1074–1075, *April* 3, 1939. —The theory proposed by Proca and Goudsmit [see Abstract 2624 (1939)] contains a constant of the dimension of a mass. From this, by means of the constants h and c it is possible to obtain a quantity of the dimension of a length, which comes out to be $4 \cdot 4 \times 10^{-13}$ cm., *i.e.*, of the same order as the classical electron radius. R. P.

***3007. Detection of Single Positive Ions, Electrons and Photons by a Secondary Electron Multiplier. J. S. Allen.** *Phys. Rev.* 55. 966–971, *May* 15, 1939.—A secondary electron multiplier tube has been developed and used successfully for counting single positive ions, electrons and photons. This tube has twelve electrodes covered with a thin layer of Be. Tests have shown that with 330 V per stage this tube will multiply the primary current by a factor of 10^5. The use of guard ring insulation and electrostatic shielding for the final collecting electrode has reduced the background current to an extremely low value. The last electrode was connected to the grid of the first tube in a linear amplifier. In order to count single positive ions or electrons the tube was waxed to the end of a simple magnetic spectrograph. Ions having energies from 50 to 20000 eV and masses from one to 32 were detected. By increasing the gain of the thermionic amplifier electrons could be counted. With still more gain single photons were counted. The multiplier tube has an extremely low background counting rate. Because a pressure of 10^{-6} mm. of Hg is maintained in the counter, it can be connected directly to the vacuum system through which the electrons or positive ions are accelerated. The absence of a thin window between the counter and the vacuum system should be a great advantage in experiments dealing with low energy positive ions or electrons. AUTHOR.

3008. Magnetic Scattering of Neutrons. O. Halpern and M. H. Johnson. *Phys. Rev.* 55. *pp*. 898–923, *May* 15, 1939.—In this paper there is contained a full elaboration of two previously published short notes on the subject of magnetic scattering of neutrons together with a comprehensive treatment of certain sides of this problem which have already received some attention from other authors. After presenting the state of the problem in the introduction the authors discuss in detail their reasons for the choice of an interaction function between neutrons and electrons, and the nonmagnetic interaction between neutrons and nuclei. The various possible cases of coherent and incoherent scattering and depolarisation phenomena are then treated. Later applications to the theory of ferromagnetic scattering are kept in mind. The general expression for the cross-section due to magnetic interaction is obtained and applied to various classes of phenomena (scattering by free, rigidly aligned, and coupled magnetic ions). The influence of the elastic form-factor is treated quantitatively with the aid of a simple model for the current distribution in the ion. Finally a series of performed or suggested experiments is discussed mainly from the point of view whether they will permit theoretical interpretation. Arrangements are described which allow a reliable value for the neutron's magnetic moment to be obtained and also give insight into the magnetic constitution of the scatterer (ion or crystal) which will exceed the knowledge obtainable from macroscopic magnetic experiments. [See Abstract 3803 (1937) and following Abstract.] Authors.

3009. Theory of Forward Scattering of Neutrons by Paramagnetic Media. J. H. Van Vleck. *Phys. Rev.* 55. *pp.* 924–930, *May* 15, 1939.—Experiments on the scattering of neutrons by paramagnetic media may have two possible goals: (*a*) determination of the magnetic moment of the neutron, and (*b*) investigation of exchange forces. In (*a*), materials of negligible exchange coupling should be used, while in (*b*) the reverse is true. The present paper is concerned with (*b*). It is shown that the exchange interaction between the paramagnetic ions tends to make the scattering inelastic, and reduces the form factor for forward scattering, so that it is no longer unity. An attempt is made to calculate the amount of this reduction. The distribution of energy changes in the inelastic processes is estimated by calculating the mean square and mean fourth power absorption frequencies, as well as the exact frequency distribution spectrum for an over-simplified " cluster " model. A Gaussian distribution appears to be the best feasible approximation. If this is used, it is estimated that in MnS, a typical material with appreciable exchange coupling, the form factor reduces the scattering of monochromatic liquid-air and room-temperature neutrons near the forward direction by about 75 and 50% respectively. [See preceding Abstract.] Author.

3010. Radiative Corrections for Electron Scattering. S. M. Dancoff. *Phys. Rev.* 55. *pp.* 959–963, *May* 15, 1939.—A relativistic treatment of the radiative correction of order e^2/hc to the elastic scattering cross-section leads to the following results: (*a*) For the scattering in an electrostatic field of a particle described by the Pauli-Weisskopf theory, the correction is finite and is given by $(\partial\sigma/\sigma)_A = -(2\alpha/3\pi)(p-k^2)ln\, g/T$ where g is a number of order unity. (*b*) For the scattering of a Dirac electron in an electrostatic field, the correction diverges logarithmically and is positive. (*c*) The convergence or divergence of the correction depends critically on the type of scattering potential considered. Author.

3011. Scattering of Protons by Protons. R. G. Herb, D. W. Kerst, D. B. Parkinson and G. J. Plain. *Phys. Rev.* 55. *pp.* 998–1017, *June* 1, 1939.—The cross-section for scattering of protons by protons has been measured at angles from 15° to 45° for protons of energies 860, 1200, 1390, 2105 and 2392 ekV. Observed scattering cross-sections at 15° are close to Mott values for all energies. Ratios of observed cross-section to Mott cross-section rise with increasing angle and with increasing proton energy. At 45° the ratio rises from 3·90 at 860 ekV to 42·9 at 2392 ekV. At 1830 ekV measurements were made at scattering angles up to 60° and the scattering cross-section showed the theoretically expected asymmetry ($\cos\theta$) about 45°. As a check on the proton-proton measurements the scattering of protons from A and Kr was investigated with protons of energies between 850 and 2440 ekV. [See following Abstract.]
Authors.

3012. Analysis of Experiments on Scattering of Protons by Protons. G. Breit, H. M. Thaxton and L. Eisenbud. *Phys. Rev.* 55. *pp.* 1018–1064, *June* 1, 1939.—The new observations of Herb, Kerst, Parkinson and Plain [see preceding Abstract] and of Heydenburg, Hafstad, and Tuve are analysed. No definite indication of a *p* wave anomaly or higher phase shifts is found. The *s* wave anomaly is the major effect observed. The phase shift K_0 responsible for it is compared with theoretical expectation using potentials which are constant (except for their Coulombian part) within distances $0\cdot75$, 1, $1\cdot25$ in units $e^2/mc^2 = 2\cdot81 \times 10^{-13}$ cm. The first of these gives a too rapid and the last a too slow variation of K_0 with energy. The interaction radius e^2/mc^2 agrees with experiment much better than the others. The potential energy giving the best agreement with experiment, when superposed on the Coulomb energy within this distance, is determined within a few tenths of a per cent and is $11\cdot3$ eMV. The Gauss error potential $Ae^{-\alpha r^2}$ with $\alpha = 16$ and with 9×10^{-13} cm. as the unit of length gives a too slow variation of K_0 with E. Experiment agrees decidedly better with $\alpha \sim 20$. An over-all fit can be obtained with $\alpha = 21\cdot6$, $A = 51\cdot4\,mc^2$. The shortening of the range of force is about the same as that previously suggested by Rarita and Present from calculations on the binding energy of H^3. This is surprising since the discovery of the electric quadrupole moment of H^2 necessitates a revision of binding energy calculations. Conclusions about the range of force derivable from proton-proton scattering experiments are shown to be sensitive to a possible velocity dependence of the nuclear potential. The proton-proton and proton-neutron forces in ^1S states are compared and it is found that for both types of potentials the proton-proton interaction is less by approximately 2%. This difference is definitely outside the probable errors in the scattering experiments and is not very sensitive to velocity dependence. The absence of p wave anomalies in the data from 1830 to 2400 ekV is not sufficiently clear cut to claim a definite disagreement with Feenberg's inequality derived from saturation requirements with exchange forces. The effects expected are close to the consistency of the measurements. The paper includes formulæ and tables for the calculation of anomalies due to phase shifts, discussions of geometrical corrections and of some of the effects of experimental errors on the conclusions. Some of the features that may be learned by extensions to higher and lower energies are pointed out. An outline is given in the introduction. AUTHORS.

3013. Diffuse Scattering of High Speed Electrons in Electron Diffraction Patterns. H. Nie. *Ann. d. Physik*, 35. 2. *pp.* 97–106, *May*, 1939.—By means of an electron-optical arrangement, it is shown that the high speed electrons which are scattered diffusely by a Au foil $0\cdot1\mu$ thick have suffered an energy loss of less than $0\cdot4$%. It is these electrons which give a dark background on electron diffraction plates. H. J. H. S.

*3014. **Construction of Magnetic Electron Microscope of High Resolving Power. A. Prebus and J. Hillier.** *Canad. J. of Research*, 17. *Sect. A. pp.* 49–63, *April*, 1939.—A brief historical review of the development of the electron supermicroscope is given. This is followed by a theoretical discussion of the resolving power attainable with the instrument and a summary of the important results which have been obtained by other workers. A description is given of the supermicroscope which has been recently constructed in Toronto. A number of photographs taken with the instrument demonstrate its high resolving power and its applicability as a tool in the sciences. AUTHORS.

3015. Effect of Chromatic Error on Electron Microscope Images. J. Hillier. *Canad. J. of Research*, 17. *Sect. A. pp.* 64–69, *April*, 1939.—The effect on the intensity distribution of point to point variation of the chromatic error in electron microscope images is investigated qualitatively. The intensity distribution in the image is found to possess a maximum value just outside, and a minimum value just inside, the image of the edge of the object. The deductions are verified by microphotometer traces taken across the photographic record of the image of a diatom edge.

It is suggested that the intensity distribution curve may be used in the physical analysis of the object. AUTHOR.

3016. Photoelectric Photography. A. Lallemand. *Comptes Rendus*, 208. *pp.* 1211–1212, *April* 17, 1939.—The electrons emitted from a photo-kathode on which a luminous image is focused are in their turn focused on a photographic plate. To obtain a satisfactory impression on the plate in a short exposure, a high accelerating voltage must be used and the pressure in the photo-cell must be extremely low. The author has produced such a cell using as sensitive surface K deposited on an oxide base. With accelerating potentials of 42,000 to 48,000 V, clear photoelectric photographs are obtained and with exposures shorter than those required for ordinary photography. W. S. S.

3017. Quality of High-Power Electron Microscope Image. B. v. Borries and E. Ruska. *Naturwiss.* 27. *pp.* 281–287, *May* 5, 1939. —In the high-power electron microscope, the image is obtained by focusing a very narrow beam of electrons with an objective which has relatively large aberrations. The normal aperture of the objective is usually of the order of 10^{-2} whilst only about 1/10 of this is used in the formation of an image. One great advantage of the electron over the optical microscope is the much greater depth of focus obtained in the former, examples of which are given. The contrast in electron optical images is discussed and an explanation is given of the light halo which surrounds the edge of the image which appears when relatively thick objects are examined under high powers and of the dark halo which appears for thin objects. The effect of electron absorption by the object is shown by heating and charging of the object but if the object is sufficiently thin this has little or no effect on the image. H. J. H. S.

***3018. Electron Microscope Technique. H. Ruska.** *Naturwiss.* 27. *pp.* 287–292, *May* 5, 1939.—A method of mounting different types of object which are to be examined in a high-power electron microscope is described and illustrated. A method involving the use of colloidal Au is also described for enhancing the contrast in an image of an object which tends to give poor contrast. H. J. H. S.

3019. Examination of Plant Virus with High-Power Electron Microscope. G. A. Kausche, E. Pfankuch and H. Ruska. *Naturwiss.* 27. *pp.* 292–299, *May* 5, 1939.—The high-power electron microscope is able to render visible the tobacco-mosaic and potato-X viruses. Photographs are shown of typical specimens of each and the structure is readily discernible. The original magnification is 20000 and the resolving limit is of the order of $10^{-2}\,\mu$. The size of the smallest particles in the structure measured on the photographs agrees with those measured by the ultracentrifuge and by X-ray means. H. J. H. S.

See also Abstracts 2824, 2832, 2873, 2964, 3035, and
1605B. Focusing Electrons of High Speed. M. Cotte.
1606B. Electron-Optical Spectrum Analysis of H.F. Oscillations. H. E. Hollmann and A. Thoma.

ELECTROSTATICS.

3020. Number of Points in which a Plane Electric Field Vanishes. L. Sobrero. *Accad. Lincei, Atti*, 29. *pp.* 70–75, *Jan.–Feb.*, 1939.—If, in a plane field produced by n conductors, the field intensity is zero at n' points between the conductors and at n'' points on the surfaces of the conductors, there must always be the relation $n' + \frac{1}{2}n'' = n - l$, provided the total charge on all the conductors is not zero, and provided points at which the field intensity has a zero of higher order are counted with their multiplicity. R. P.

***3021. Transport of Electric Charges by Droplets. M. Moureau-Hanot.** *Comptes Rendus*, 208. *pp*. 1492–1494, *May* 8, 1939.—Advantages of replacing the solid particles in an electrostatic generator working with a current of gas [see Abstract 3255 (1937)] by liquid droplets are summarised, and experiments are described with an apparatus using droplets of a mixture of CCl_4 and vaseline. In an apparatus of four ionisers properly designed, each drop could be charged or discharged 16 times on an average before striking the walls. To obtain 500 μA, 100 cm^3. must be atomised per min., the drops being 1 μ in radius. The process is thus capable of supplying a reasonable current. A. J. M.

3022. Volta Effect in Solid Metallic Alloys. O. Scarpa. *N. Cimento*, 16. *pp*. 1–13, *Jan*., 1939.—Systematic measurements of the Volta effect of metallic alloys of varying concentration in air have been carried out. Three types of alloys have been investigated: metals of unlimited solubility in the solid state (Cu-Ni), alloys of complete insolubility (Sn-Zn) and alloys containing intermetallic compounds (Cu-Zn). In the first case the voltage increases with increasing content of Ni; in the case of the binary alloy Sn-Zn, a very small quantity of Zn added to the Sn is sufficient to reduce the voltage to zero. The system Cu-Zn shows a maximum at a concentration of 90% Zn corresponding to the compound Cu Zn_6, and a minimum for 96% Zn content. The results are analogous to other physical phenomena of these alloys. L. K.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3023. Magneto-Resistance of Nickel in Large Fields. C. W. Heaps. *Phys. Rev.* 55. *pp*. 1069–1071, *June* 1, 1939.—The magneto-resistance of a nickel foil has been measured in fields up to 24,000 gauss. A drop of the curves in large fields is found, in disagreement with Alocco's results on similar material, but in agreement with Gerlach's theory that a resistance decrease is produced proportional to the square of the increase of spontaneous magnetisation. The constant of proportionality is shown to be dependent on the temperature. It is concluded that spontaneous magnetisation may be increased by a magnetic field without saturation appearing, even up to fields of 200,000 gauss as produced by Kapitza. AUTHOR.

MAGNETISM AND ELECTROMAGNETISM.

3024. Magnetic Moment of Ferromagnetic Alloys. Part I. R. Forrer. *J. de Physique et le Radium*, 10. *pp*. 181–187, *April*, 1939.—The atomic moments of ferromagnetic alloys lie between high and low limits which are clearly defined. All the Fe-Co-Ni alloys, except for Fe itself, are activated; in the series Ni-Co, Fe-Co (except up to Fe_3Co) and Fe-Ni (except up to Fe_3Ni), the activation is the same ($A'_4 = \frac{1}{2}$), whilst for the region Fe up to Fe_3Co and Fe_3Ni, the activation increases linearly. The conception of the atomic moment already put forward by the author [see Abstract 843 (1939)] is again described and its bearing on the results quoted is briefly discussed. H. J. H. S.

3025. Minimum Thickness of a Layer of Iron Showing Discontinuities in Magnetisation. S. Procopiu. *Comptes Rendus*, 208. *pp*. 1212–1214, *April* 17, 1939.—Discontinuities in the magnetisation of a thin coating of electrolytic Fe on a Cu wire were observed by passing a.c. through the stretched and twisted wire and recording the inductive effects produced in a surrounding solenoid. These effects increase with the a.c. to a certain limit which depends on the thickness of Fe. At thicknesses below 1·75μ inductive effects are no longer obtained and it is concluded that this value must be a lower limit to the linear dimension of the elementary regions introduced by Weiss in explaining discontinuities of magnetisation. The minimum thickness of Fe showing reversible magnetic effects had previously been found to equal 0·035μ. Both limits are in reasonable agreement with the conclusions of other workers. W. S. S.

3026. Effect of Internal Stress and Grain Size on Magnetic Properties of Pure and Silicon-Iron. V. Kostomaroff. *Comptes Rendus*, 208. *pp.* 1304–1306, *April* 24, 1939.—The author reports results of the examination of annuli of 10·8 and 9·1 cm. external and internal dia., in ingot Fe and 4% Si-Fe; magnetically, by reflection and transmission of X-rays, and microscopically. Annealing at 1000° C. and 930° C. gives respective permeabilities of 5880 and 6800 for Fe, 3850 and 11230 for the alloy, coercive force drops to 0·71 from 0·80 and to 0·35 from 0·77, number of grains per mm. decreases from 38 to 10·5 and from 32 to 24. Further, the Laue spots become larger and less numerous at the higher temperature, especially with prolonged heating. He emphasises the beneficial effect of removing lattice strains by decarbonisation in H_2, and disputes the contention that examination of Laue spots is itself sufficient to define magnetic properties of an iron specimen. These can vary immensely with the state of crystallisation. On the other hand, by use of monochromatic radiation and measurement of the intensity of reflection within the ionisation chamber, magnetic characteristics and lattice structure can be correlated much more exactly. [See also P. P. Cioffi, *Phys. Rev.* 45. *p.* 742, *May* 15, 1934.] D. R. H.

3027. Magne-Crystallic Action. Part VI. Paramagnetic Crystals (continued). K. S. Krishnan, A. Mookherji and A. Bose. *Roy. Soc., Phil. Trans.* 238*A*. *pp.* 125–148, *March* 20, 1939.—The magnetic anisotropies of some typical salts of the rare earth and the Fe groups have been measured at low temperatures down to about 90° K. A simple cryostat, with automatic temperature control, suitable for measurements of the magnetic anisotropies of crystals at low temperatures, is described. The results are discussed on the basis of the theory of paramagnetism in crystals developed by van Vleck, Penney and Schlapp. In those crystals in which the paramagnetic ions are all in the S-state, *e.g.*, $Gd_2(SO_4)_3 \cdot 8H_2O$, $Mn(NH_4)_2(SO_4)_2 \cdot 6H_2O$, the anisotropy $\Delta\chi$ is found to vary inversely as the square of the absolute temperature. In $Gd_2(SO_4)_3 \cdot 8H_2O$ the maximum anisotropy, though only 1·4% of the mean susceptibility at room-temperature, is still much larger than should be expected from the Stark separation of the S-levels of Gd^{+++} under the crystalline electric fields. The bulk of the observed anisotropy appears to arise from the magnetic interaction between the neighbouring Gd^{+++} ions. Chromic salts have a very feeble anisotropy, almost as feeble as if the Cr^{+++} ion were in the S-state. The criterion for judging the suitability of a paramagnetic salt as working material in the production of low temperatures by the Debye-Giauque method is discussed. From measurements on the magnetic anisotropy of Ni salts at different temperatures, the strength of the coupling between the orbital and the spin angular momenta of Ni^{++} is calculated, and is found to agree with the spectroscopic value. Pr and Sm ethylsulphates are of special interest. On going down to low temperatures their anisotropies increase at first, reach a maximum, and then diminish rapidly. The crystal fields in the rare earth chlorides, which are hexahydrated, are as strongly asymmetric as in the sulphates, which are octahydrated. Magnetic measurements on the cupric alkali chlorides enable a decision to be made between the alternative structures proposed for these crystals from X-ray studies. [For Part V see Abstract 2176 (1938).] AUTHORS.

3028. Susceptibility of Oxyhaemoglobin. P. Berthier. *Comptes Rendus,* 208. *pp.* 1435–1437, *May* 1, 1939.—Following on previous work [see Abstract 2242 (1939)], the effect of NaOH and HCl on oxyhaemoglobin is observed. With NaOH the oxyhaemoglobin becomes diamagnetic, but in time returns to the paramagnetic state. In the presence of HCl the susceptibility increases with time to a maximum and afterwards diminishes. The susceptibility of the different concentrations diminishes as the pH value increases. G. E. A.

3029. Effect of Traces of Impurities on the Magnetic Properties of Platinum. R. Théron. *Comptes Rendus,* 208. *pp.* 1634–1636, *May* 22, 1939.—The magnetic properties of Pt can be changed by thermal treatment (*e.g.*, annealing at from 1000° to the fusion point, followed by tempering in air, H_2 or *in vacuo*). Examination of the experimental conditions of the thermal treatment reveals that in each case where a change was observed the Pt was in presence of vapours (Mn, C, Mo or their oxides), and the attribution of the magnetic transformations to these vapours is supported by the fact that the transformations can be obtained by the addition of traces of these substances. [See Abstract 3232 (1931).] W. R. A.

3030. Magnetic Measurements on Alkali Metal Amalgams. W. Klemm and B. Hauschulz. *Zeits. f. Elektrochem.* 45. *pp.* 346–353, *May,* 1939.—The magnetic susceptibility of pure Hg, Na, K, Rb and Cs is measured and the systems Na-Hg, K-Hg, Rb-Hg and Cs-Hg are examined magnetically over the range 20–183° C. The susceptibility-composition curves show maxima, minima and transition points, most of which may be attributed to definite compounds, as they give corresponding thermal effects. Some compounds, however, only give magnetic transition points whilst others may only be detected by thermal means. H. J. H. S.

3031. Magnetic Properties of B, Ti, Zr, Th and V. L. Klemm. *Zeits. f. Elektrochem.* 45. *pp.* 354–357, *May,* 1939.—The values of the atomic and gramme susceptibilities of B, Ti, Zr, Th and V at + 20 and − 183° C. are given. H. J. H. S.

3032. Magnetic Properties of Sc, Y and La. H. Bommer. *Zeits. f. Elektrochem.* 45. *pp.* 357–362, *May,* 1939.—Measurements of the susceptibility of Sc, Y and La are described. Sc behaves like Pd and Pt in that the susceptibility is large and increases rapidly as the temperature falls whilst Y and La show only small temperature effects. H. J. H. S.

3033. Phase Relations and Magnetic Properties of the System $Ti\text{-}O_2$. P. Ehrlich. *Zeits. f. Elektrochem.* 45. *pp.* 362–370, *May,* 1939.—An examination of Ti oxides of composition $TiO_{2\cdot00}$ to $TiO_{0\cdot58}$ by means of X-rays shows that there are 4 phases in this range; α-, from $TiO_{2\cdot00}$ to $TiO_{1\cdot90}$, β-, from $TiO_{1\cdot80}$ to $TiO_{1\cdot65}$, γ-, from $TiO_{1\cdot56}$ to $TiO_{1\cdot46}$ and δ-, from $TiO_{1\cdot25}$ to $TiO_{0\cdot6}$. A deformed α- phase may also occur. Magnetic measurements suggest the existence of " free " Ti^3 ions, the number of which increases as the O_2 content increases. H. J. H. S.

3034. Magnetic Properties of Salts of the Iron Group at Low Temperatures. W. J. de Haas and B. H. Schultz. *K. Onnes Lab. Leiden, Comm. No.* 256*d. Physica,* 6. *pp.* 481–496, *June,* 1939. *In English.* A short survey is given of older measurements on the anhydrous salts with remarks concerning the methods used in the present work. Results are given of the measurements on $CoCl_2$, $CoBr_2$, CoF_2, $Ti_2(SO_4)_3$, and $Mn(C_2H_3O_2)_3 \cdot 2H_2O$. A discussion will be given in a following paper, which will also deal with other salts. [See also Abstract 1393 (1939).] AUTHORS.

3035. Diamagnetism of Electron Gas. A. Papapetrou. *Zeits. f. Physik,* 112. 9–10. *pp.* 587–604, 1939.—Mathematical. The magnetic susceptibility of an electron gas calculated at very weak fields depends on the geometric form. In strong fields a strong diamagnetism, independent of geometric form, is expected [see Abstract 5469 (1937)]. W. R. A.

3036. Electrodynamic Conception of Magnetic Energy. L. Puccianti. *N. Cimento,* 16. *pp.* 34–41, *Jan.,* 1939.—The author defends his conceptions of the correspondence between B and E on one hand and H and D on the other hand from the electrodynamic point of view. He denotes B_0 as magnetising force which is identical with the magnetic force B *in vacuo* while H is defined as magnetic excitation. Giorgi made the objection that the analogy between E and H, D and B followed from the work done by the electric and magnetic field: $dW_e = EdD$ and $dW_m = HdB$. The author shows that this objection can be overcome as the processes in the case of a magnetic field are fundamentally different from those in an electric field. This diversity has its origin in the fact that the work in the electric field is done by overcoming the resistance of a static force, but in the magnetic field by overcoming a force analogous to inertia. L. K.

3037. Torque Between Concentric Single-Layer Coils. C. Snow. *Bureau of Standards, J. of Research,* 22. *pp.* 607–626, *May,* 1939. —This paper is concerned with several types of small correction terms which must be taken into account when computing the torque or the mutual inductance between two concentric single-layer helices. These are to be added to the formula previously developed for two current sheets [see Abstract 1321 (1929)]. The seven types of corrections are those which may be foreseen from experience with other absolute electrical measurements. Many others will arise which cannot be anticipated at this time. AUTHOR.

See also Abstract 2705.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3038. Steady Polarity Potential of the Eye. W. R. Miles. *Nat. Acad. Sci., Proc.* 25. *pp.* 128–137, *March,* 1939.—The resting polarity potential of the eye is measured by a previously described method [see Abstract 1832 (1939)] for three age groups of normal females and for a further different age group of mixed males and females. Series of measurements on different days demonstrate the reliability of the measurements. Marked individual differences in potential are observed both in respect of absolute magnitude and day to day variation. There is slight but not conclusive evidence of a curvilinear relationship between age and potential; the standard deviations of the steady potential appear to decrease with increasing age. It is not found possible to correlate the steady eye potential with the potential of surrounding tissues. The relations between the different electrode leads by which steady potentials can be measured in association with 30° lateral fixations appear quite constant in normal subjects. The measured potentials are consistently smaller on the second day than on the first day; this tendency is attributed to a psychological factor relating to familiarity of the subject with the measurement routine. J. E. K.

3039. Polarity Potentials from the Human Eye. D. B. Lindsley and W. S. Hunter. *Nat. Acad. Sci., Proc.* 25. *pp.* 180–183, *April,* 1939.—Electrodes were affixed to the skin around the eye and the potentials developed between pairs of these electrodes following eye motions in different directions were measured. The records show clearly the polarity difference between the front and back of the bulbus, which are positive and negative respectively. The potentials are of an entirely different kind from muscle action potentials. Although they have been termed corneo-retinal potentials no satisfactory explanation of their origin has yet been established. W. S. S.

***3040. Technique of Iterative Excitation. J. Lefebvre.** *J. de Radiologie et d'Électrologie,* 23. *pp.* 207–211, *May,* 1939.—When physiological tissues are excited by electrical means, some tissues, whilst insensitive to a single electrical stimulus, respond to a stimulus applied repeatedly more or less rapidly, such being termed iterative excitation. An example occurs when the nerve tissue has an intrinsic rapid response and the muscle tissue intrinsic lag of response. An apparatus to investigate this phenomenon due to Walter is described and illustrated. Intensity and duration of the impulse is modified by variation of the discharge of condensers *via* a non-inductive resistance, at a voltage which can be doubled, to measure the chronaxy of the tissues, by means of a suitable key. The interval between successive condenser discharges is determined by a revolving point contact or cam. This apparatus utilises a constant degree of response for a wide variation of the exciting impulse. A further apparatus due to Bremer is briefly described which allows determination of the value of the response to a constant stimulus and is applicable to certain complex conditions. Illustrative stimulus-response curves are given. B. J. L.

***3041. Computation of Dimensions in Planigraphy with Mathematical Instruments. D. H. Drummond and W. W. Schmela.** *Radiology,* 32. *pp.* 550–555, *May,* 1939.—The authors present tables for use in planigraphy from which the necessary mathematical relationships can be read off directly. From this, the height of various planes can be determined for their respective shifts on the plate. Conversely, the degree of shift of the plate necessary for localisation of any given plane can be found when it is desired to use the double exposure method. Correction factors are listed to correct for distortion of linear and area relationships produced by divergence of the X-ray beam from the target. The use of the pantograph and planimeter is outlined for the rapid reproduction of plane boundaries, areas, and the computation of volumes. AUTHORS.

***3042. Ultra-Violet Meter. A. H. Taylor.** *J.O.S.A.* 29. *pp.* 218–219, *May,* 1939.—Briefly describes a simple pocket-size u.v. meter, in which an a.c. supply is connected to a Cu_2O rectifier and charges a condenser, thus giving a d.c. supply to a Cd-alloy photo-cell. A selector switch connects one of 3 different condensers, for range variation, in series with the cell, and across the cell and series condenser is a ½ W Ne tube in series with a telephone receiver. When the photo-cell receives u.v.

radiant energy a current flows through it and charges the selected series condenser. This discharges through the lamp and telephone receiver when the voltage reached 75 V, and causes an audible click in the receiver, the intensity of the energy being directly proportional to the rate of the clicks. R. C. F.

3043. X-Ray Therapy by the Method of Chaoul. E. P. Pendergrass, P. J. Hodes and C. J. Garrahan. *Radiology*, 32. *pp.* 142–154, *Feb.*, 1939.—An account is given of some measurements of the intensity of output and the clinical results obtained with a shock-proof X-ray tube designed for contact therapy. The generator is a constant potential one using a modified Greinacher circuit delivering 4 mA at 45 kV. The electron beam in the X-ray tube passes down an earthed metal cylinder, striking at the end a target of Au-plated Ni. The X-rays emerge through the target which is water-cooled and the total inherent filtration is equivalent to 0·2 mm. Ni which includes the water-cooling (approx. 2 mm.). The isodose curves were measured by using an ionisation chamber, active volume 3 mm^3. due to Mayneord [see Abstract 2417 (1936)]. The average output was found to be 90–100 r./min. at 5 cm. and 200–245 r./min. at 3 cm. and an estimated 2000 r./min. at contact (3 mm.). The half value layer determined in Al was 2·4 mm. corresponding to an effective wave-length of 0·38 Å. Pin-hole photographs of the focal spot revealed it to be 1·6 cm. in dia. There is a radial variation in intensity, it falls off 30–40% towards the periphery of the field. Backscatter increases with the focal area of the applicator, approaching a limiting value of 20%. The percentage depth dose was determined in a water phantom and found to vary from 60–25% at 1 cm. depth, as the target-skin distance decreases from 5 cm. to 3 mm. In the clinical results, doses are recorded as r. measured in air without backscatter and the daily dose per field varies from 100–400 r. In some instances as much as 3000 r. have been delivered in one sitting and doses as high as 9000 r. over a period of 25 days, to one portal, have been delivered without ill effects. In the majority of cases 400–450 r. given at one time produces a threshold erythema. In most malignant cases, a total dose of 8000 to 10000 r. has produced a complete regression. It is concluded that l.v. therapy (Chaoul technique) is indicated as a procedure of choice in lesions so situated that short treatments are desirable and in selected cases in which it is desirable to obtain the maximum amount of effect in the superficial tissues. T. A. C.

3044. Value of Assessing and Prescribing Dosage in Radiation Therapy in Simple Terms. R. Paterson. *Radiology*, 32. *pp.* 221–227, *Feb.*, 1939.—It is considered that the essential primary factors are: (1) *Dose*, or quantity of radiation absorbed; (2) *quality*, or wavelength of radiation, and (3) *time*, or duration of treatment. Some methods of recording dosage which the author believes should be discarded are: Röntgens in air, erythema dose, summated röntgens to treatment fields, ergs and I-Mc, radium erythema dose, millicurie-hours and millicuries destroyed. Reinhart, Quimby and previously Kingery are attempting to devise methods of combining dose and time under one concept—the " cumulative " dose. At the moment however, with inadequate experimental foundation for these theories, it is desirable to state " dosage in relation to time," *e.g.*, 6000 r. in 8 days, 2250 r. in 1 hour, and so on. The assessing of dosage in radium interstitial therapy is very complex, but by a combination of mathematical and physical means, sufficiently useful methods of assessing dosage can be devised, even in very complex arrangements of radioactive foci. This was first achieved satisfactorily in terms of ergs/cm^3. by Murdoch and Stahel. In articles published by Parker and the author [see Abstract 2633 (1938)] simpler dosage systems for both superficial and interstitial radium therapy are outlined. The author considers that, the value of thinking and prescribing in the literal sense of the word, *i.e.*, prescribing the real dosage to tumour and skin is unquestionable. Once the habit is acquired the difficulties of the old method are forgotten. Put shortly, tumour dose is thought of first, skin dose next, and last of all the technique by which the dose will be delivered. Three examples of a simplified statement of treatment figures are given. (1) 4750 r. in 8 days is a lethal dose to 80% of squamous-cell carcinomas; (2) 8000 r. in 10 weeks is a sub-lethal dose to the majority of squamous-cell carcinomas; (3) skin tolerance, for a small area, ranges from just under 3000 r. in 1 hour, to well over 10000 r. in 10 weeks. T. A. C.

3045. Measurement of X-Rays from a Tube Actuated by a van de Graaf Generator. J. C. Hudson. *Radiology,* 32. *pp.* 530–537, *May,* 1939.—Absorption curves in Pb, Sn and Cu are given for the radiation at 1000 kW from an X-ray tube actuated by a van de Graaf generator. For clinical use an added filter of 3·3 mm. Pb, 2·6 mm. Cu, and 2 mm. Al is used. This results in a mean wave length of 0·021 Å as determined from half value layers in Pb, Sn and Cu, and a value of dose per min. per mA of 47 r. in air, at a treatment distance of 70 cm. AUTHOR.

***3046. Alignment of X-Ray Beams. W. V. Mayneord.** *Brit. J. of Radiology,* 12. *pp.* 257–258, *May,* 1939.—In order to obtain a more exact positioning of the patient it is often necessary to know the precise location of the beam, especially at its exit as well as at the incident surface. An optical device for finding these data is here described. It consists of a brass tube, along the axis of which the X-ray beam passes. By means of a small pea lamp either in the axis of this tube or in a side tube at right angles to it and reflecting along it by means of a 45° mirror a beam of light can be sent along this axis in the opposite direction to the X-ray beam. This spot of light, falling on the patient's body shows where the X-ray beam will emerge. G. G.

***3047. Electric Adding Machine and its Use in Radiation Therapy W. V. Mayneord.** *Brit. J. of Radiology,* 12. *pp.* 260–262, *May,* 1939.—The calculation of applied dosage at any selected point in an irradiated volume is a laborious process and the author has adopted a Victor electrical adding machine to eliminate most of the labour. In addition to finding the dose at a variety of points in the tissues it also assists in plotting charts showing the progress of the treatment, the determination of the radiation dose at a given point with alternative arrangement of fields and the plotting of γ-ray distributions in the vicinity of Ra containers. The chief application so far is in the determination of the radiation distribution around complex Ra sources. E. H. W. B.

***3048. Dose Contour Projector and its Application to Three-Dimensional Radiation Distributions. W. V. Mayneord.** *Brit. J. of Radiology,* 12. *pp.* 262–268, *May,* 1939.—A projection stand is described in which a given diagram showing isodose curves in a principal plane is used as a basis to produce isodose contours in any other plane. The original diagram is made on a transparent plate such as a photographic negative, and mounted in a stand capable of rotation about two normal axes. Below is a base-plate carrying drawing paper on which can be moved a stand carrying a stylus at the top and a pencil below. In use the plate is rotated about one axis and the stylus moved to correspond to the given point on the isodose curve. The pencil is depressed and points or lines are drawn on the paper corresponding to the given plane. Models are also made of a number of such transparencies taken in different planes and mounted at a fixed distance apart. A further application is to the plotting of dosage for given points in a part under radiation by constructing a plaster model of the part. E. H. W. B.

3049. Three-Dimensional Radiation Distributions. *Brit. J. of Radiology*, 12. *pp.* 269–302, *May*, 1939.—In previous papers [see three preceding Abstracts] apparatus is described for determining approximate 3-dimensional distributions of radiation which occur in X-ray and Ra therapy. The present symposium is based on examples of the applications of this apparatus to dosage problems.

" Distribution of Radiation in Planes Inclined to the Axis of an X-Ray Beam," by **W. V. Mayneord** (pp. 269–276).—In X-ray therapy the radiation beam is not usually perpendicular to the plane containing the lesion to be treated, and it becomes important to know the distribution of radiation in planes inclined to the beam. This problem is well exemplified in the treatment of breast and pelvis with multiple sloping fields. The dose contours were studied, therefore, in planes inclined at angles of 30°, 45° and 60° to the axis of a standard X-ray beam (200 kV, 1 mm. Cu filter, 50 cm. f.s.d., 10 cm. dia. field). A large number of isodose charts are given showing the distribution of radiation in such planes at tissue depths of 0, 2, 4, 6, 8 and 10 cm.The most interesting feature is the considerable displacement which occurs between the point at which the axis of the beam cuts a given plane and the point at which the maximum dose occurs in that plane. This displacement is of great importance in arranging fields for " crossfire" treatments.

" Distribution Due to Two Directly Opposing X-Ray Fields," by **D. W. Smithers** (pp. 276–281).—The simplest two field technique is discussed, consisting of two equal circular fields, directly opposed, with a common axis. Using previously obtained principal plane isodose contours for the two separate fields, and adding the doses at numerous points, principal plane contours for the two fields together are obtained. The volume distribution is obtained by rotating this diagram about the common axis of the beams. The isodose surfaces are visualised by the transparency method previously described [see Abstract 3048 (1939)]. For the higher dose rates the isodose surfaces are a series of rounded cones with their bases at the centre of each field in the surface and apices on the common axis. These are surrounded by lower dose rate surfaces in the form of a series of " diabolos," changing gradually to a true cylinder. Surrounding this cylinder are a series of low dose rate barrel-shaped surfaces. The application of these results to the treatment of the larynx, the tongue and the lip is briefly discussed.

" Distribution of Radiation in the Female Pelvis," by **D. W. Smithers** (pp. 281–287).—The volume distribution of a simple four or five field technique for X-ray irradiation of the pelvis is investigated. Using the standard isodose transparency above (*ibid.* pp. 269–276) applied to four symmetrical fields with axes in one plane and angled to the mid-point, the distribution through the pelvis in the principal planes is first determined. Then, by means of the contour projector [see Abstract 3048 (1939)] the distributions due to these fields in parallel planes above and below the principal plane are obtained. When these curves are drawn on transparent sheets and suitably superimposed, the full volume distribution is seen. This distribution brings out the fact, that dosage in planes below the cervix may, for some types of case be inadequate. The addition of a perineal field at right angles to the principal plane and 8 cm. below is therefore discussed. It is shown that this addition results in a much more uniform distribution of radiation over a larger volume.

"Distribution of Radiation in a Three Field Technique," by **L. F. Lamerton** and **W. V. Mayneord** (pp. 288–291).—The case here considered is that of three standard X-ray fields (see above, *ibid.* pp. 269–276] whose axes are all inclined at 30° to a horizontal plane, and meet in a common axial focus, an arrangement approximating to a common technique for breast treatments. Contour diagrams are superimposed in the correct relative positions, and using the adding machine previously described (see Abstract 3047 (1939)] the combined distribution of the three fields in a series of horizontal planes is worked out. There is triangular symmetry in the upper planes, but at greater depths the contours become nearly circular. Although the fields are directed at a point some 5 cm. deep the maximum dose occurs approximately in the plane of entry (see above, *ibid.* pp. 269–276). This is further illustrated by the study of distribution in vertical planes.

"Distribution of Radiation in Planes Inclined to the Axis of a γ-Ray Beam," by **J. Honeyburne** (pp. 291–296).—Using the methods described above (*ibid.* pp. 269–276) the distribution in planes at an angle to the beam from a teleradium unit has been studied. Two fields from a 5 gm. unit (8 cm. dia. and 45° inclination, and 5 cm. dia. and 60° inclination), and one field from a 1 gm. unit (3 cm. dia. and 30° inclination) have been used. Curves are given in each case for several depths.

"Distribution of Radiation in a Head and Neck, using a Five Field Teleradium Technique," by **J. Honeyburne** (pp. 296–297).—A mould is made of the patient's neck and the positions of the five fields to be used for treatment are marked out. This is fitted to the dose-finder [see Abstract 3048 (1939)] together with the standard isodose curves for the unit, and the distribution due to the five fields is determined in a series of 9 horizontal planes. Curves of these distributions are given and indicate the asymmetry of the contours. The method may be used to find the optimum arrangement of fields in any particular case.

"Distribution of Radiation in Planes Inclined to a Ring Source of Radium," by **J. Honeyburne** (pp. 297–300).—Using previously obtained isodose curves for a ring source (see Abstract 3770 (1937)], together with the contour projector, the distributions at 4 different depths when the ring is inclined at 30° to the surface plane, have been obtained. This example illustrates the value of the volume distribution method for surface Ra applicators, and may be used to study the effects of faulty arrangement of Ra on such applicators.

"Distribution of Radiation in the Neighbourhood of Radium Needles," by **J. Honeyburne** (pp. 300–302).—The method of the previous section is applied to the distribution in planes inclined to a single Ra needle. As an example of a distribution which would be very tedious to calculate, but is of practical interest, three needles are set in skew positions with respect to one another, and the distribution of radiation found in a plane containing one needle and inclined at 45° to the other two. J. E. R.

✱3050. Secondary Filters in Radium Therapy. E. H. Quimby, L. D. Marinelli and J. V. Blady. *Am. J. of Roentgenology*, 41. *pp.* 804–818, *May*, 1939.—Ra and Rn, used for γ-ray therapy, are enclosed in a metallic filter to remove the primary β-rays. The emerging γ-rays however set up secondary β-radiation, and, to remove this, a secondary filter is required. Data which have been published show that the amount of secondary radiation produced in such secondary filters of organic material, or metals of low atomic weight, may be of the same order of magnitude as the β-rays after passage *via* a filter of heavy atomic weight, *i.e.*, secondary filtration may be of no value. The effects of secondary radiation are of practical importance in therapeutic use of Ra and Rn, and details are given of measurements made by past investigators. The authors describe an ionisation chamber for the measurement of the secondary radiation, such ionisation measurements being checked against skin erythema tests, the results being strictly comparable, since the same radioactive unit of radiation was used. The two series of experiments show that the secondary radiation is definitely less for substances of intermediate atomic number, and the use of such filters as stainless steel or nickel is preferable to filters of rubber or celluloid. The absorption of secondary radiation has been measured in a celluloid-like substance Catalin, which is easier to machine than celluloid and shows that differences of absorption actually disappear after passage *via* 1 mm. of this tissue-like substance, indicating that skin erythema and pigmentation result from changes occurring in the first millimetre of tissue irradiated. The value of the γ-ray erythema dose expressed in " tissue roentgens " corresponds with the authors' previous measurements, with a different applicator and ionisation chamber. B. J. L.

✱3051. Effect of Cable Length on Radiation Output of Shockproof X-Ray Tubes. T. H. Rogers. *Radiology*, 32. *pp.* 202–208, *Feb.*, 1939.—Shockproof cables introduce a capacitive load on the plant, and tests are described on various types of rectified circuit and various cable lengths, giving the effect on the output for different voltages and currents. The general summary is as follows: 4-valve, full-wave; output considerably increased. 2-valve, half-wave; output may be increased or decreased depending on voltage, current and cable length. Single-valve, half-wave; Villard and self-rectified; little effect on output. In general cable capacitance imposes a higher thermal load on the transformer but the radiographic output is increased at a greater rate. Various curves of results are given. E. H. W. B.

See also Abstract 2927.

OSCILLATIONS AND WAVES.

3052. E.H.F. Resonances in Positive-Grid Triode. R. A. Chipman. *Phys. Soc., Proc.* 51. *pp.* 566–574, *July*, 1939.—A triode with a cylindrical electrode system had its grid maintained at a positive potential, and its plate at a small negative mean potential, with respect to the filament. If an oscillating potential was superposed on the mean plate potential it was found that plate current flowed and the magnitude of this plate current was determined as a function of the grid potential. There were maxima of plate current for certain values of grid potential, and it was shown that these could be interpreted in terms of a fundamental or harmonic resonance between the period of the applied oscillating potential and the time of transit of the electrons between different pairs of electrodes in the triode. AUTHOR.

3053. Propagation and Total Reflection of Electromagnetic Waves in the Ionosphere. M. N. Saha and K. B. Mathur. *Indian Journ. Phys.* 13. *pp.* 1–12, *Feb.*, 1939.—A critical review is given of S. N. Bose's paper [see Abstract 3873 (1938)]. It is shown that when the collision frequency is taken to be zero, his method gives the same result for the propagation of radio waves as that of earlier workers. The conditions of reflection which he has deduced for the case where collision cannot be neglected appear to require revision. AUTHORS.

3054. F-Region at Allahabad. R. R. Bajpai and B. D. Pant. *Indian Journ. Phys.* 13. *pp.* 57–71, *Feb.*, 1939.—Results of measurement of virtual height of the F-region carried out (mostly at night) during 1937–38 session on several wave frequencies are described. It is found that the nature of the equivalent height change varies in a marked manner from day to day. Sometimes the virtual height shows three maxima during a single night. A good correlation has been found to exist between the hour of occurrence of minimum virtual height of the F-region and the hour at which the barometer at ground level reads maximum pressure. Occasionally echoes from ionised regions above the normal F-layer have been obtained. Occurrence of complex echoes is found to be associated with variation of one or other of the terrestrial magnetic elements. It is seen that contrary to the results obtained by many investigators the F_1-region exists till about 10 o'clock at night. [See also Abstract 3872 (1938).] AUTHORS.

3055. F-Region Ionisation in June, 1938, at Allahabad. K. B. Mathur and G. R. Toshniwal. *Nat. Acad. Sci., India, Proc.* 9. *pp.* 6–10, *March*, 1939.—The paper deals with the determination of the critical penetration frequency of the F_1-region during the summer solstice period, 1938. The mean of these observations shows that the ionisation begins to increase an hour after the ground sunrise and it attains its maximum value of 14·7 Mc./sec. ($2 \cdot 67 \times 10^6$ electrons/cm^3.) at 17·00, *i.e.*, two hours before ground sunset. AUTHORS.

3056. Partial Reflection and Calculation of Apparent Heights of Ionospheric Layers. K. Rawer. *Hochfrequenztechn. u. Elektroakustik*, 53. *pp.* 150–157, *May*, 1939.—An exact solution of the wave equation is obtained for a plane wave incident normally on a horizontal ionospheric layer in which the dielectric constant varies according to : $\epsilon = 1 -$ const. $e^{\kappa\xi}/(1 + e^{\kappa\xi})^2$ where ξ is the height above the mid point of the layer. This function is symmetrical about a value $\epsilon_{\min}$ at $\xi = 0$. Partial reflection and apparent heights are then investigated. In most cases, when $\xi_{\min} < 0$, the wave is reflected, and when $\epsilon_{\min} > 0$ it penetrates. The amplitudes of reflected and transmitted waves decrease exponentially with the collision frequency and the layer thickness, while the apparent height measured from the middle of the layer increases with the thickness. These relations fail, however, when appreciable partial reflection occurs, as in layers whose half-thickness L is less than 1·4 wave-lengths. The reflection coefficient at the critical frequency is 0·707 and in the absence of damping the apparent height at the critical frequency has the finite maximum value $L/1 \cdot 53 \cdot (\log_{10} L/\lambda + 1 \cdot 10)$. J. P. A.

3057. Nature of Atmospherics. Part VI. F. E. Lutkin. *Roy. Soc., Proc.* 171*A*. *pp.* 285–313, *June* 6, 1939.—The study of atmospherics originating from British storms indicates that in storms of the heat type destruction of negative cloud moments accounts for almost all the flashes, while in clouds of the " frontal " type positive moments are destroyed as frequently as negative ones. In 80% of cases negative cloud moment is destroyed while many of the remainder, although indicating an initial destruction of positive moment, show finally the destruction of negative moment. The time taken and the number of current pulses in the same ionised channel in these cases is described. Details are given also of the average peak current, and the character and amplitude of the field changes. From sources over the sea the duration of the individual oscillatory trains is greater than for sources originating over land. While the predominant frequency of these oscillations is of the order of 10 kc./sec. reflections from low ionised regions are thought to produce the h.f. embroidery seen on patterns from distances of 10–100 kc./sec. and result in such atmospherics being troublesome in the medium wave bands. [See Abstract 4734 (1937).] R. S. R.

See also Abstracts

1725B. Effects Caused in the Ionosphere by Electric Waves. V. A. Bailey.
1730B. Dielectric Resonators. R. D. Richtmyer.

PHOTOELECTRICITY.

3058. Cu-Cu$_2$O Photo-Cells. N. F. Mott. *Roy. Soc., Proc.* 171*A* *pp.* 281–285, *June* 6, 1939.—The behaviour of Cu-Cu$_2$O photo-cells is interpreted in terms of a theory of the contact between a metal and a semiconductor recently given by the author [see Abstract 2193 (1939)]. AUTHOR.

3059. Spectral Sensitivity Curves of Selenium Barrier-Layer Cells. P. Görlich. *Zeits. f. Physik,* 112. 7–8. *pp.* 490–500, 1939.—The spectral sensitivity curve of normal Se photo-cells is measured and compared with curves given by previous investigators. Cells with a photosensitive CdSe layer are prepared ; they have a sensitivity maximum of 540 mμ compared with 560–590 mμ for normal Se cells. By a suitable forming process the Cd can be applied so as to produce perturbing centres in the Se layer and then the overall sensitivity is increased and a new subsidiary intensity maximum appears at 710 mμ. J. E. K.

See also Abstract 3076.

PIEZOELECTRICITY.

3060. Dependence of Propagation Velocity of Flexural Vibrations on Frequency. F. Krista. *Zeits. f. Physik,* 112. 5–6. *pp.* 326–338, 1939.—An investigation was made of the dependence of the propagation velocity of flexural vibrations on the frequency for a number of rectangular quartz plates for the general case where the plate executes stationary flexural vibrations whose nodal lines form two systems of parallel straight lines at right angles to one another. Such vibrations are produced by the interference of flexural vibrations propagated in two directions in the plane of the plate and in this case, for experimental proof of the theory, only quartz plates cut perpendicular to the optic axis should be employed, since only in the plane perpendicular to the optic axis are the modulus of elasticity and Poisson's ratio constant and independent of the direction. The results are presented in a series of curves in close agreement with theory. Explanation is made of the slight discrepancies observed. [See also Abstract 215 (1931).] A. W.

3061. Vibrations of Piezo-Quartz. F. Seidl. *Zeits. f. Physik,* 112. 5–6. *pp.* 362–363, 1939.—Two micro-photographs of Chladni-figures on the surface of a piezo-quartz of 1552 kc./sec. proper frequency which had broken in two pieces after having been stressed above the elastic limit. The photographs show concentric rings whose distance apart would correspond to a velocity of the elastic waves of 4% under the value measured by Langevin and others for perfect elastic conditions. Some harmonics are visible. L. E. F.

3062. Equivalence of Two Piezoelectric Oscillating Quartz Crystals of Symmetrical Outlines with Respect to a Plane Perpendicular to an Electrical Axis. I. Koga. *Phil. Mag.* 27. *pp.* 640–643, *May*, 1939.—Two piezoelectric oscillating quartz crystals, symmetrical in their outlines and in their relationship to the electrodes referred to a plane perpendicular to an electrical axis, are equivalent. Accordingly, any piezoelectric oscillating quartz can always be uniquely determined by merely having its relationship to the *r*-face, *r'*-face and *m*-face clearly identified, and it does not matter whether the mother crystal is right-handed or left-handed. AUTHOR.

THERMIONICS.

3063. Fluctuations in Thermionic Current and the "Flicker Effect." M. Surdin. *J. de Physique et le Radium,* 10. *pp.* 188–189, *April*, 1939.—It is shown theoretically that the fluctuations in a thermionic current known as the "flicker effect" are due to variations in the number of free electrons in the metal. H. J. H. S.

3064. Measurement of Intensity of Potassium Atomic Beams from an Incandescent Tungsten Surface. Part I. K. Kodera. *Chem. Soc. Japan, Bull.* 14. *pp.* 114–120, *April*, 1939.—The intensity of the K atomic beams emitted from an incandescent W surface is examined for a W ribbon instead of with the usual W-wire. Relations are established between the ionisation efficiency and (*a*) the ribbon temperature, (*b*) the surface concentration of the adsorbed atoms. F. C. C.

* **3065. Conditions for Producing Intense Ionic Beams. L. P. Smith and G. W. Scott, Jr.** *Phys. Rev.* 55. *pp.* 946–953, *May* 15, 1939.—Conditions for the optimum production of positive ions and their complete removal from the ionisation region to form a beam are developed. The calculations take into account the variations in ionisation cross-section as a function of electron energy. The mechanism of proton production is considered and the efficiency of arc type sources is discussed. AUTHORS.

3066. Material Radiation Accompanying Kathode-Ray Emission from a Hot Kathode. W. Reichelt. *Phys. Zeits.* 40. *p.* 387, *May* 15, 1939.—Experiments showed that the kathode-ray emission from a brightly glowing W wire in the high vacuum furnished by a diffusion pump is accompanied by material radiation which is deposited round the starting-out point and hinders the damping of the material there. Cd was found very suitable for investigating the effect. A pure Cd layer subjected to a kathode beam concentrated by means of an electron lens yielded a fine dense layer which protected the underlying metal. The deposit can be obtained on a small glass plate placed in the path of the rays, when a strongly reflecting dark brown spot is obtained, whose density increases with the duration and intensity of the radiation. A. W.

THERMOELECTRICITY.

See Abstract 2983.